MITSUBISHI ELECTRIC
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TECHNICAL TRAINING
2003

Projection Television Technical Training & Troubleshooting Manual





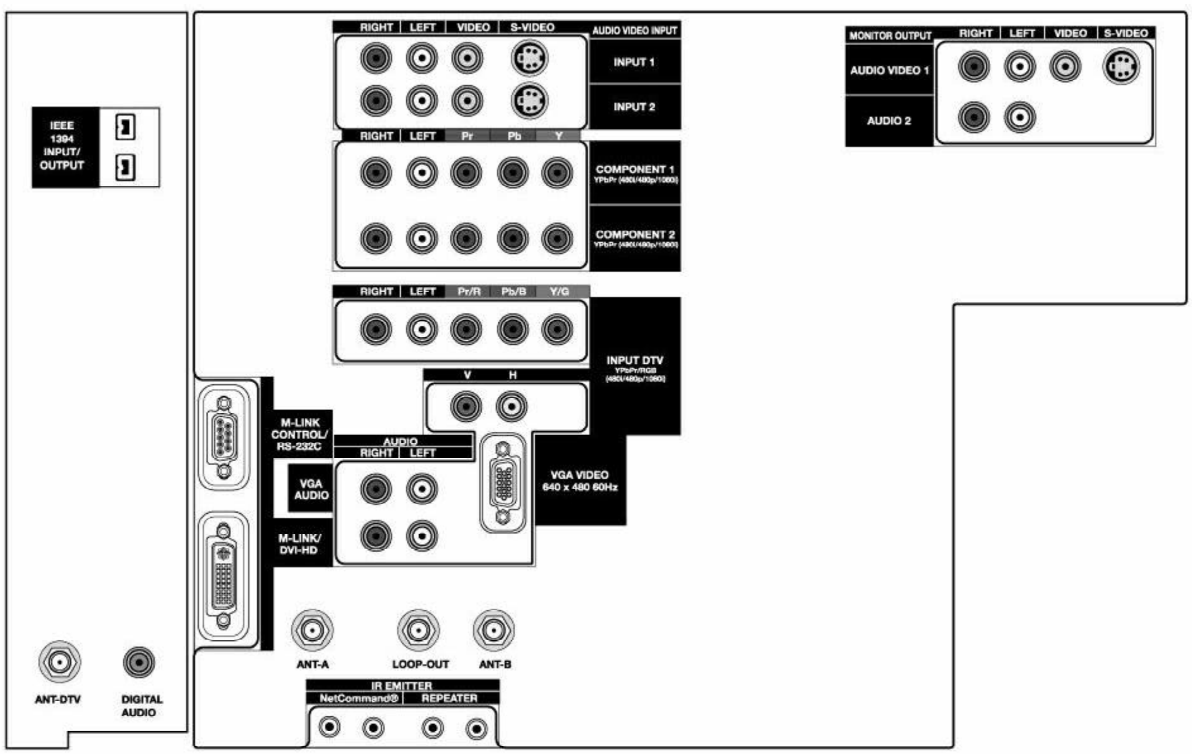
V23	V23+	V23++	V23+++
WS-48513	WS-48613	WS-65713	WS-55813
WS-55513	WS-55613	WS-73713	WS-65813
WS-65513	WS-65613		
WS-73513			

MITSUBISHI ELECTRIC
MITSUBISHI DIGITAL ELECTRONICS AMERICA, INC.

Technical Training

2003

V23 Chassis Projection Television Technical Training & Troubleshooting Manual



V23 CHASSIS
TECHNICAL TRAINING AND TROUBLESHOOTING MANUAL

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Introduction

	Series	Gold	Gold Plus	Platinum	Diamond
	Chassis	V23	V23+	V23++	V23+++
Screen Size	48" W	WS-48513	WS-48613		
	55" W	WS-55513	WS-55613		WS-55813
	65" W	WS-65513	WS-65613	WS-65713	WS-65813
	73" W	WS-73513		WS-73713	

Table 1: V23 Models

The V23 Chassis is carried in the *Gold*, *Gold Plus*, *Platinum* and *Diamond* series models for 2003 and 2004. This full featured, integrated HDTV chassis represents the latest technologies in CRT based projection television. A breakdown of V23 models is shown in *Table 1*.

Features

Table 2 shows some of the major features by model category. Some of the features are carried over from previous years, some have been improved upon and some are totally new. In addition to all the user features, the V23 chassis includes many serviceability features.

Carry Over Features
- IEEE1394, FireWire
- DTV Link
- VGA Input
- QuadField Focus
- TruFocus Lenses
- Gold Plated Jacks
- 2 Piece Cabinets (65" & 73")
- Fine Pitch Lenticular Screen
- Anti-glare DiamondShield

Improved Features
- 3rd Generation HDTV Receiver
- NetCommand 3.0 with IR Learning
- PerfectColor - All Inputs and Signal Types
- AMVP™ Improved Performance
- 9" CRTs now available in a 65" Model
- Coaxial and 2-way speaker systems
- Contemporary cabinet in a 55" Model

New Features
- 5 Format Memory Card Reader
- MonitorLink™ Input
- Low Energy Mode

Serviceability Features
- Modular design with "Light Box"
- Self Diagnostics
- Serviceable to Component or PCB level.
- ATSC Tuner/Decoder circuitry separated from DM assembly.
- Reduction in number of stand-up PCBs.
- Service Adjustment Mode Data Reset.

This section will provide further explanation on the following features that are either new or may have the most impact on service:

1) NetCommand 3.0
2) 5 Format Memory Card Reader
3) PerfectColor
4) MonitorLink

V23 Features	
Feature	**Explaination**
3rd Generation HDTV Receiver	ATSC and Unscrambled QAM Reception Greater Sensitivity
NetCommand™ 3.0	Home Theater Control by Firewire or IR
Five-Format Memory Card Reader	For viewing JPEG digital photos and listening to MP3 or WMA audio recordings.
AMVP (Advanced Multimedia Video Processor)	8 Screen Formats, Improved Line Doubling and Noise Reduction
FireWire/IEEE1394	Digital Home Networking Interface.
DTV-LINK	Standard for future FireWire interfaces.
PerfectColor™	Individual Control of 6 Colors
Low Energy Mode	Reduced Power Consumption in Standby
MonitorLink™ Input	Digital Video Input
VGA Input	640x480 - 60HZ

V23+ Features (Additional Features)	
QuadField Focus™	Magnetic Focus Assembly on CRT Neck. Results in smaller electron beam.
Two-way Coaxial Speakers	WS-55613 & WS-65613. Improved Audio.

V23++ Features (Additional Features)	
Tru-Focus™ Lenses	Improved and more uniform focus.
Two-way Speaker System	6" Woofer & 1.5" Tweeter for improved audio.
Gold Plated Jacks	Gives high quality connections.

V23+++ Features (Additional Features)	
Contemporary Cabinet	High Gloss Black. Composite Back has Reduced Weight
Fine-Pitch Lenticular Screen	Best Horizontal Resolution
Anti-glare DiamondShield™	Reduction in Reflections
9" CRT (WS-65813)	Improved Brightness and Resolution

Other Features	
9" CRTs in all 73" Models	Improved Brightness and Resolution
2 Piece Cabinet (65" & 73" Models)	Simplifies Delivery

Table 2: Features

NetCommand 3.0

NetCommand allows most common home theater products to be connected and controlled by way of the TV's remote control by simply selecting on-screen icons. See *Figure 1*.



Figure 1: NetCommand Icons

The control interface can be by one of two means.

- IEEE1394/Firewire
- Infrared (IR Blaster)

The 3rd generation of NetCommand offers additional functionality and a simplier user interface.

When using the Firewire, NetCommand is "plug-and-play." For the end user, it makes all digital video, audio and control connections with one cable (*Figure 2*).

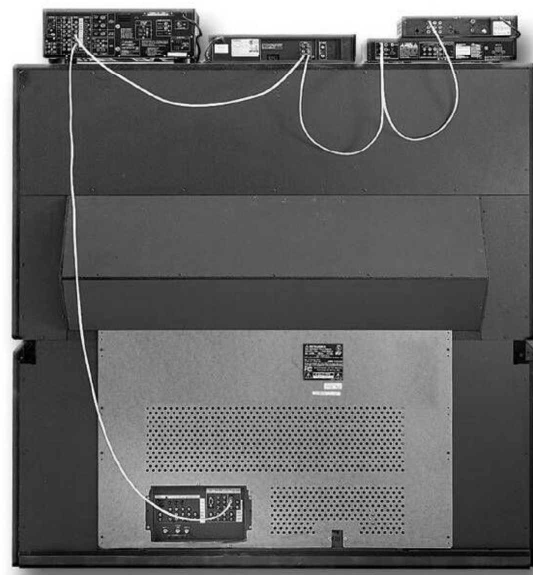


Figure 2: FireWire Connection

All other configuration is automatic. For control, the industry standard sofware supported includes:

- **AV/C** - Includes common functions such as Stop, Play, FF, RWD, etc.
- **HAVi** - Includes AV/C but also allows a higher level of sofware communication for a more interactive interface.

When using IR, an IR blaster must be connected to the TV and placed in front of the device to be controlled. The TV must then be configured so the proper IR codes will be used.

Like previous versions of NetCommand, an "IR Library" is loaded in the TV's software so that most common devices can be selected for immediate use. New for NetCommand 3.0 is the "Learning" feature. For devices that are not included in the IR Library, NetCommand can memorize the IR code from that devices remote. A series of menus walks the customer through the learning process. Once loaded, the TV can then control the device using the IR blaster. This makes NetCommand almost 100% compatable with all other IR controlled devices.

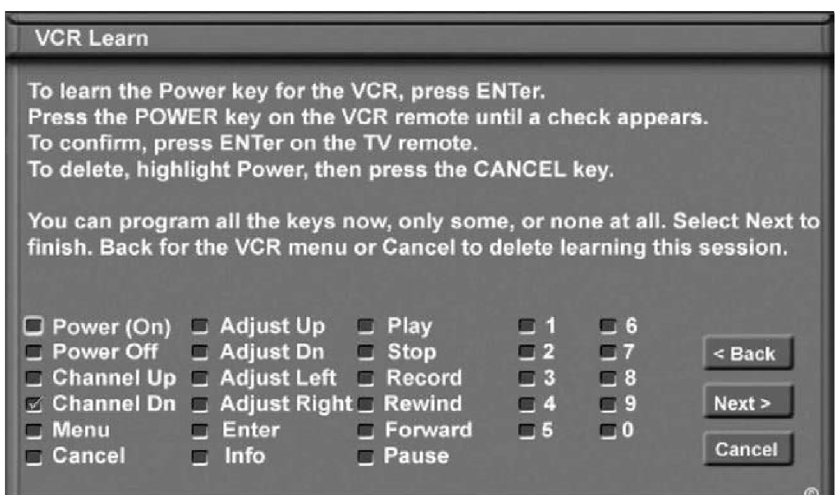


Figure 3: IR Learning Menu

5 Format Memory Card Reader

Digital music and photography can now be enjoyed in the home theater environment thanks to the memory card reader featured in the V23 chassis. When the user inserts a memory card into any one of the four card reader slots on the front of the set, NetCommand will take control, allowing a slide show or giving a music play list.

The memory card formats supported are:

- Memory Stick™
- MultiMedia Card™
- SD (Secure Digital)
- SmartMedia™
- CompactFlash®

When a memory card is inserted into the correct slot, an LED next to the slot will light up. Then, after the slot is selected using the DEVICE button on the remote, the Memory Card Screen, *Figure 4*, will be automatically displayed.

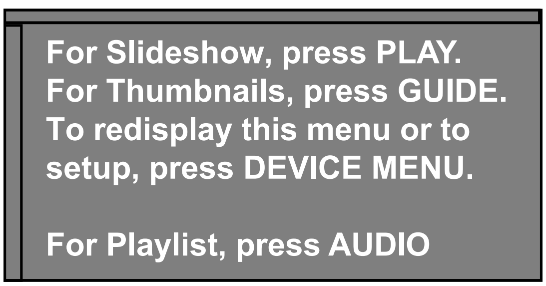


Figure 4: Memory Card Screen

An overview of remote push buttons and their functions is given in *Table 3*. Other remote functions are explained within the menus. Full instructions are included in the *Owner's Guide*.



Figure 5: JPEG Thumbnails

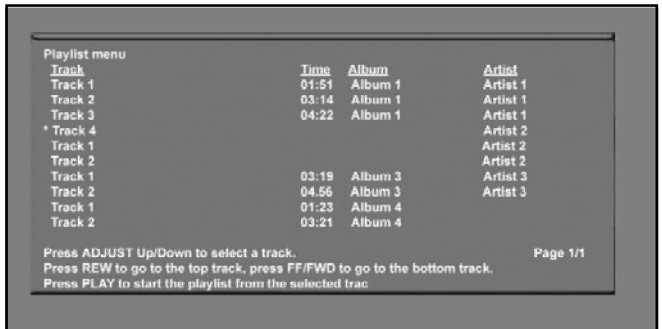


Figure 6: Audio Playlist

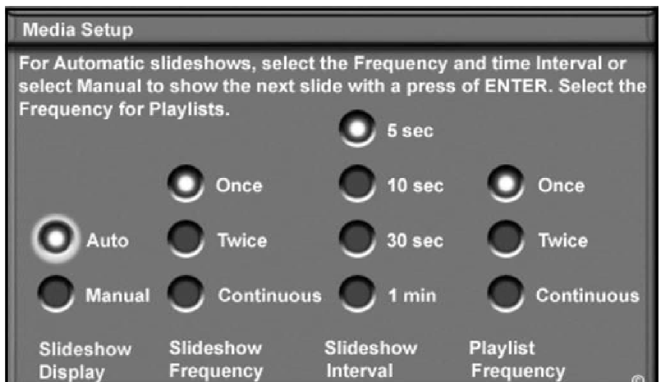


Figure 7: Media Setup

BUTTON	FUNCTION
VIDEO	Switch from Audio Play List to JPEG Thumbnails (Figure 5)
AUDIO	Switch from JPEG Thumbnails to Audio Playlist (Figure 6)
DEVICE MENU	Display the Media Setup Menu (*Figure 7*)
PLAY	Start the Slideshow or play audio
GUIDE	Return to the Thumbnail menu or the Audio Playlist while in Play
PAUSE	Pauses or resumes playback
FF	Skips to the next slide or song
REW	Returns to the previous slide or song
STOP	Stops slide show or play and returns to Memory Card Screen
FORMAT	Rotates slide 90° each time it is pressed

Table 3: Remote Functions

Compatibility

Users having difficulties with the memory card reader should be aware of the following requirements:

For JPEG Pictures up to 128mb:

1. Still images recorded using the Exchangable Image File Format (EXIF) for digital still cameras and Design Rules for Camera File Systems (DCF).
2. Standard digital images with a maximum size of 5-megapixels (2560x1920).
3. File name maximum of 50 characters ending with a .jpg extension.

For MP3 or WMA7 Audio files:

1. Files recorded with sampling rates of 32 KHz, 44.1 KHz or 48KHz.
2. Files recorded with fixed bit rates.
3. File names with .jpg or .wma extensions.

NOTES:
Images opened and resaved on a computer may not playback or may not be able to display a picture in the thumbnail list. This is because the computer may change the file to an incompatible format.

For audio playback, the audio output from the TV to the A/V receiver is analog. Digital audio output is not available.

PerfectColor™

With conventional tint controls providing only a tradeoff between red and green, PerfectColor was developed to provide precise control over the 6 individual primary and secondary colors.

Introduced in the V20 Chassis, PerfectColor was initially limited to 480i composite video sources only. For the V22 and V23 chassis, PerfectColor can be setup individually for each and every Input and is compatible with all video source formats. (480i, 480p, 1080i)

A colorbar chart with slider controls is provided in the menu for easy reference. See *Figure 8*.

PerfectColor can also provide automatic color correction. Compared to conventional "Auto Color" systems, it can better sense and correct for color differences when changing channels. It is specifically designed for the customer that watches a wide range of channels where no one setting can be used.

NOTE: Improperly set, PerfectColor can exhibit a wide variety of color symptoms. These symptoms will not affect the on-screen menus or a black and white picture. In such instances, be sure to check the PerfectColor settings prior to troubleshooting.

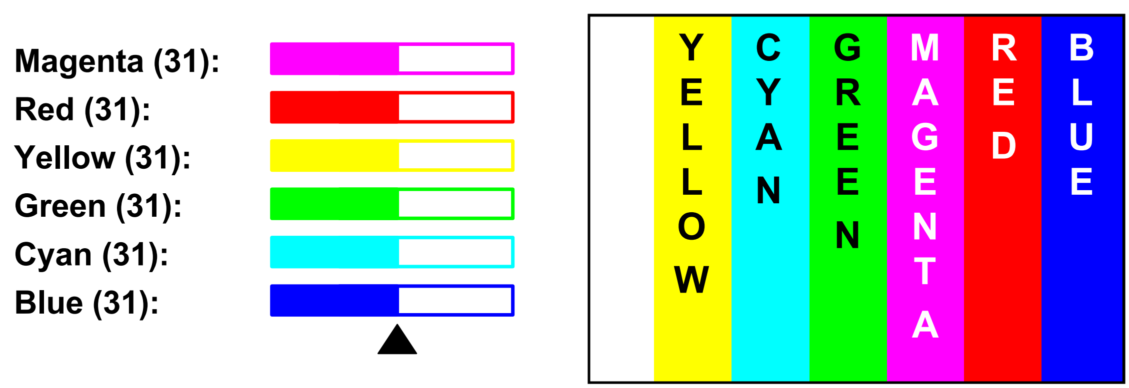


Figure 8: PerfectColor On-Screen Display

MonitorLink™

MonitorLink is a new digital interface introduced in Mitsubishi's 2003-2004 model line, including the V23 chassis.

MonitorLink provides a proprietary connection for Mitsubishi's HD-5000, Monitor/Receiver, allowing Mitsubishi's upgradeability promise to be fulfilled using a digital, rather than analog, interface.

While MonitorLink is a proprietary connection, it uses industry standard technologies that may provide even more versatility.

- **RS-232C** - Provides device communication and control.
- **Audio** - Standard analog stereo connections.
- **DVI** - (Digital Visual Interface) Provides a digital video connection.

RS-232C… The RS-232C connection interfaces communications and control between the receiver/controller and display. Commands such as Power On, Input, Mute, etc., make the system operate as one via the customer's remote control.

Audio… Analog Left and Right Audio connectors are provided for the set's internal audio/speaker system. The V23 chassis has digital audio outputs and IEEE1394 for more advanced connections with an external A/V receiver.

DVI… Technicians experienced with computer monitors may already be familiar with DVI and its features. However, because it is new to home theater, it will be covered here further.

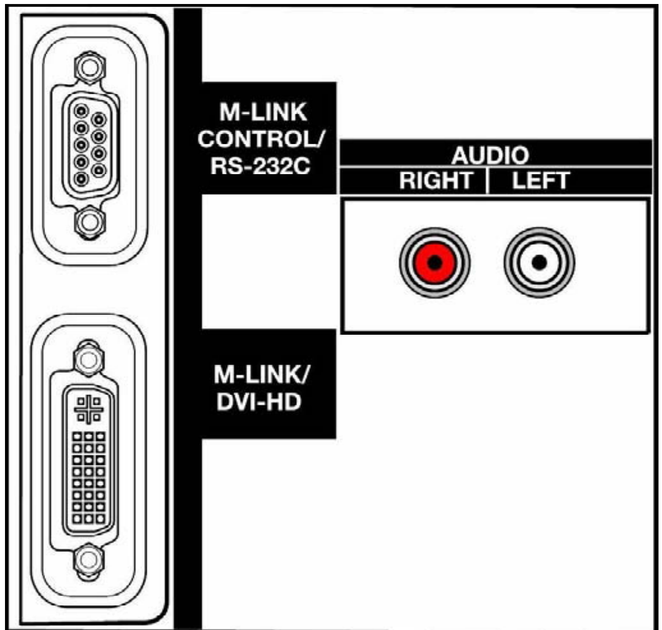


Figure 9: MonitorLink Input

Digital Visual Interface (DVI)

DVI was originally designed by the Digital Display Working Group (DDWG) to provide a universally accepted digital connection between a PC and a display device.

At first glance, another digital interface would seem unnecessary with the presence of IEEE1394, Firewire. However, differences between IEEE1394 and DVI make them each suitable for different applications. A comparison of the two interfaces, as applied to home theater, is provided in *Table 4*.

Simply stated, 1394's bi-directional, compressed data, and AV control capabilities make it suited for recording and networking between various devices. DVI's high speed, full bandwidth capabilities make it most suitable to connect a display device.

IEEE1394	DVI
Bi-directional interface (Record and Playback)	One direction interface (One way to a display)
Networkable between multiple devices	Single point-to-point.
Distributes Compressed Data (MPEG2)	Uncompressed Data (High bit rate HDTV)
Supports A/V Commands (AV/C & HAVi)	No AV Control capability
Copy Protection (5C)	Copy Protection (HDCP)

Table 4

Acronyms	
DDC	Display Data Channel
DDWG	Digital Display Working Group
DMPM	Digital Monitor Power Management
DVI-A	Digital Visual Interface - Analog
DVI-D	Digital Visual Interface - Digital
DVI-I	Digital Visual Interface - Integrated (Digital or Analog)
EDID	Extended Display Identification Data
HDCP	High-bandwidth Digital Content Protection
TMDS	Transistion Minimized Differential Signaling
VESA	Video Electronics Standards Association

Table 5

Used with its optional copy protection scheme, DVI makes it possible to view full resolution signals without exposing the signal to copyright infringement. It is the digital equivalent of component DTV connections (Y,Pr,Pb) that can be configured for use in a copy protected environment.

The DVI standard supports the following…

- Analog only interface (DVI-A)
- Digital only interface (DVI-D)
- Analog or Digital interface (DVI-I)
- Transition Minimized Differential Signaling (TMDS)
- Display Data Channel (DDC)
- Extended Display Identification Data (EDID)
- High-bandwidth Digital Content Protection (HDCP)
- Hot Plug Detect (HPD)
- Digital Monitor Power Management (DMPM)

A glossary of acronyms is provided in *Table 5*.

DVI-A, DVI-D, DVI-I

DVI can provide an analog link, DVI-A, or a digital link, DVI-D. The integrated link, DVI-I, was designed to support either. Each link has its own type connector, covered later in this article. MonitorLink uses digital only DVI, so the focus of the remainder of this discussion will concentrate on the digital link.

Transition Minimized Differential Signaling (TMDS)

TMDS is a method used to transmit digital data that reduces the number of bit transitions (high to low or low to high) occurring in the serial bit stream. To reduce the transitions, it uses an advanced formula (algorithm) that converts 8 bit data into 10 bit data. Differential circuitry is then used to output complimentary signals. The results are…

- Reduced Electromagnetic Interference (EMI).
- Faster transfer rates with reduced errors.
- Ability to use twisted pair wire vs. coax.

A TMDS link consists of a TMDS Transmitter that encodes and sends a data stream to a TMDS Receiver, see *Figure 10*. Three sets of twisted pair wires carry the Red, Green and Blue data. An additional twisted pair carries the timing clock signal.

Because the bandwidth over copper wire is limited to about 165 MHz, DVI can use up to two TMDS links, or 6 channels sharing the same clock. DVI with a dual-link TMDS has a bandwidth that is doubled.

1080i HDTV, with a pixel rate of 1920 X 1080 at 30Hz can be supported by a DVI interface operating in the single-link mode.

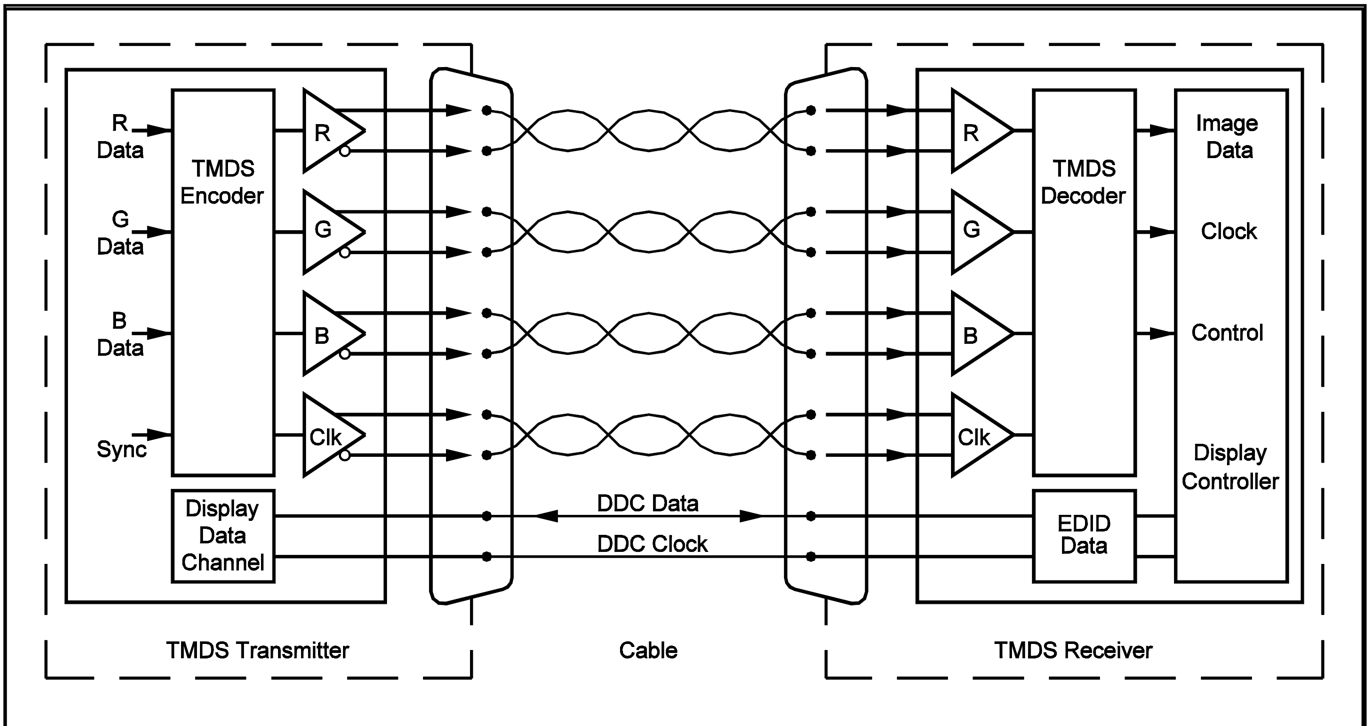


Figure 10: Single-Link TMDS

Display Data Channel (DDC)
The VESA standard Display Data Channel, shown in *Figure 10,* is part of the DVI specification. It is an I^2C bus used for data communications between the two devices. The data can include information specifying the type of display device connected and can also be used to support copy protection.

Extended Display Identification Data (EDID)
EDID is the VESA standard protocol used over the DDC so the display device can communicate identification about itself to the host device. The data, stored in memory in the display device, can include its resolution, sync timing and refresh rates, etc. It is part of the plug and play package.

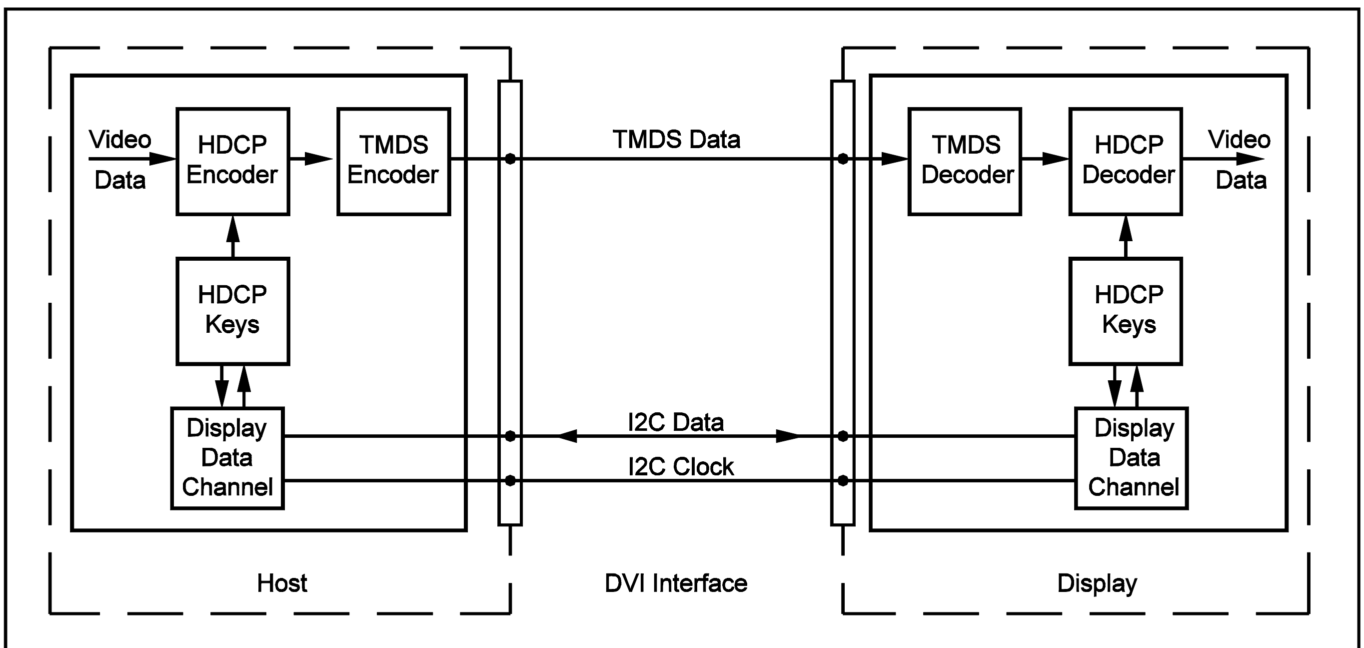


Figure 11: HDCP

High-bandwidth Digital Content Protection (HDCP)

HDCP is a system designed to protect the outputs of a DVI device from being copied. The protection can be applied in various ways.

- Unrestricted copies
- Limited number of copies
- Limited use of copies
- No copies

Since this is a optional element of DVI, both the host device and the receiving device must be properly equipped to function and provide the protected link between them. There are three parts within the content protection scheme.

- **Authentication…** The host and receiver exchange data to confirm the receiver is authorized to receive the protected data.
- **Encryption/Decryption…** After the host has verified the receiver, "keys" are provided that will allow the receiver to decrypt the data sent.
- **Renewability…** Each receiver is given both a secret code and a non-secret identification number. If the host determines the secret keys have been tampered with, the receiver is denied authentication.

The authentication process occurs over the DDC I^2C bus shown in *Figure 11*. After authentication, the encrypted video data is applied to the TMDS encoder. The encrypted data sent over the DVI interface is then immune to "eavesdropping." Only the authorized display device can reverse the encryption afterwards.

Hot Plug Detect (HPD)

Another part of the plug and play package is the VESA standard Hot Plug Detect. A dedicated pin on the DVI connector is used by the display to let the host know it is plugged in. When the host device detects a High condition greater than 2.4 VDC (typically 5.0 VDC), it will read the EDID and start operation. If the potential falls below 2.0 VDC the TMDS transmitter is stopped.

Digital Monitor Power Management (DMPM)

DMPM allows several different levels of power management by detecting the presence of EDID and/or TMDS activity. One pin on the DVI connector is provided so the host can supply a 5 V source. The display has the option to use this supply to keep the DDC capable while the monitor is off.

DVI Connectors

There two types of DVI receptacles shown in *Figure 12*, DVI-D and DVI-I. Pin assignments are detailed in *Table 6*. It should be noted, the additional pins, C1-C5, arranged in the + shape on the DVI-I receptacle, are provided for analog signals. No DVI-A connector is shown because DVI-A is generally associated with adapting VGA connectors to DVI-I.

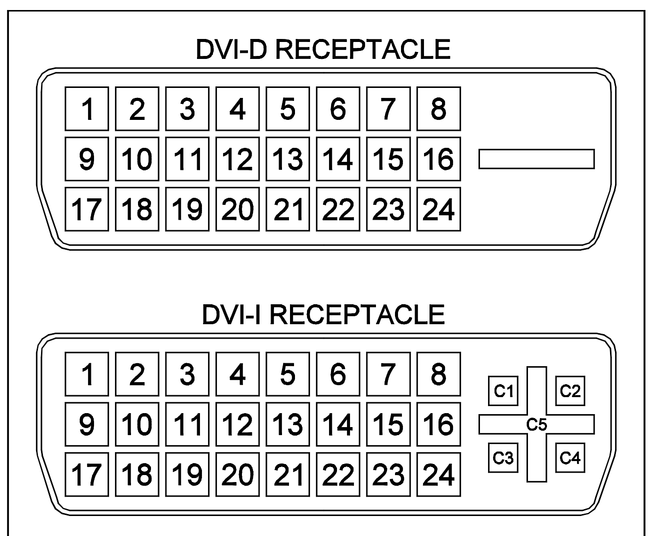


Figure 12: DVI Receptacles

PIN	SIGNAL	PIN	SIGNAL
1	TMDS Data 2-	16	Hot Plug Detect
2	TMDS Data 2+	17	TMDS Data 0-
3	TMDS 2&4 Shield	18	TMDS Data 0+
4	TMDS Data 4- (NA)	19	TMDS 0&5 Shield
5	TMDS Data 4+ (NA)	20	TMDS Data 5- (NA)
6	DDC Clock	21	TMDS Data 5+ (NA)
7	DDC Data	22	TMDS Clock Shield
8	Analog Vertical Sync (NA)	23	TMDS Clock+
9	TMDS Data 1-	24	TMDS Clock-
10	TMDS Data 1+	C1	Analog Red (NA)
11	TMDS 1&3 Shield	C2	Analog Green (NA)
12	TMDS Data 3- (NA)	C3	Analog Blue (NA)
13	TMDS Data 3+ (NA)	C4	Analog Horizontal Sync (NA)
14	+5.0 VDC	C5	Analog Ground (NA)
15	Ground	(NA) *Not used by MonitorLink*	

Table 6

MonitorLink DVI Connector

Some manufacturers use DVI-I connectors for DVI-D only. This is the arrangement used by MonitorLink. **This configuration will not support analog connections.** Therefore, any attempt to interface analog signals, no matter what form of DVI-A or DVI-I cables or adaptors used, will not be successful. Looking at the pin assignments in *Table 6*, it should become obvious, the DVI-I connector used by MonitorLink is a digital only, single-link TMDS interface.

NOTE: V23 models are compliant with HDCP and EIA861 standards for standard, extended and high definition (480i, 480p, 1080i) video. The DVI input is not intended for use with personal computers or devices outputing video signals with computer resolution.

DVI Input Block Diagram

Figure 13 is a block diagram of the DVI input circuitry used on the V23 Chassis. The circuitry will be similar in other models.

Single-link TMDS Data and Clock signals are applied directly to IC2D00. Vcc for the EEPROM, IC7AAA, is supplied by the host device via the DVI connector, pin 14. At the same time, this potential is fed back to pin 16 for Hot Plug Detection. The host device communicates over the DDC bus directly with the EEPROM to retrieve the EDID. IC2D02 is used to convert the 5V I^2C to 3.3V logic for compatibility with IC2D00 where HDCP data is exchanged.

IC2D00 decodes and outputs analog RGB/H/V signals for selection by the TV input select circuitry.

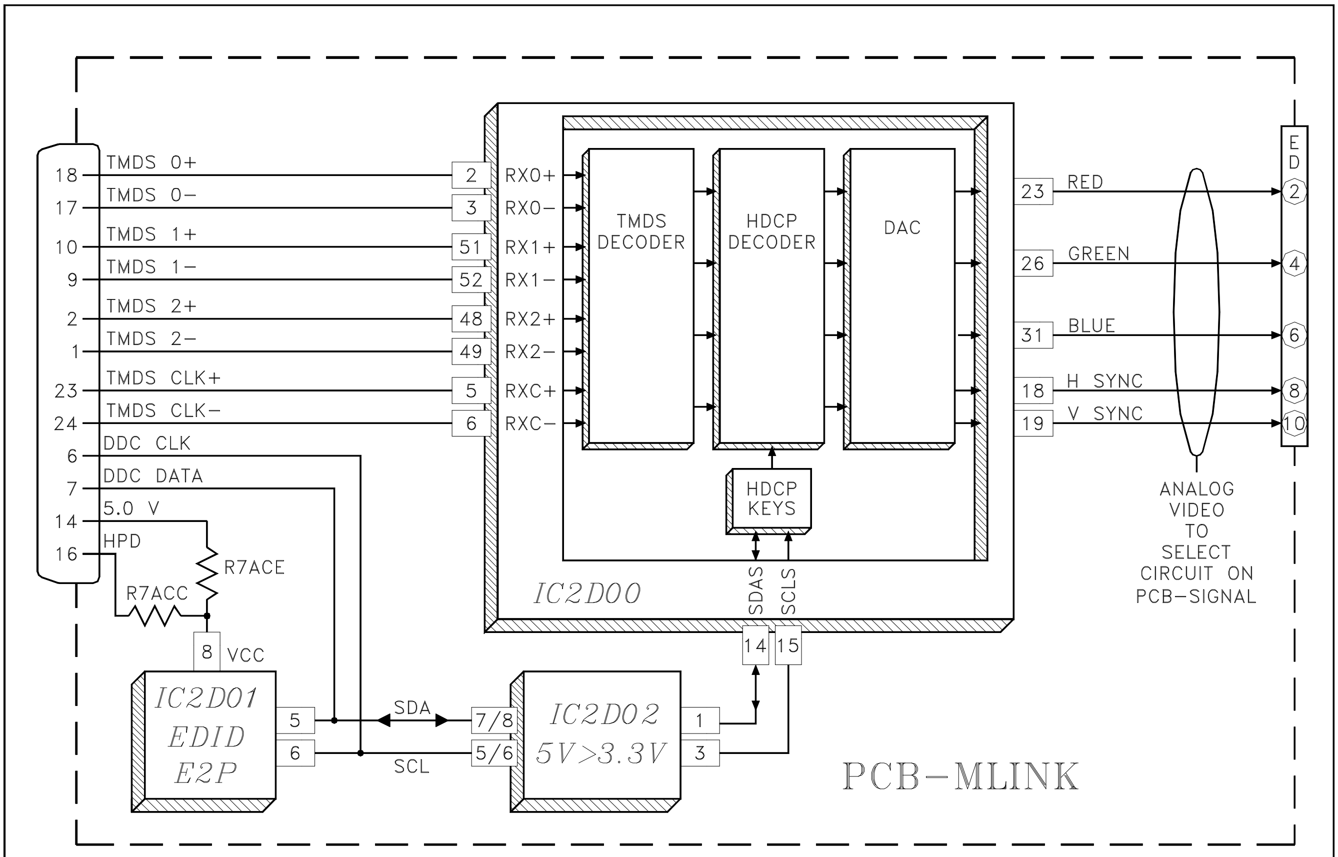


Figure 13: V23 Chassis DVI Input Block Diagram

Chassis	Option Menu	Adjustment Mode	Convergence Mode	OSD Position
VZ5/VZ6/V15	1-3-7-0	2-3-5-7	2-3-5-9 <6><5><4>	Adjust Mode
VZ7/VZ8/V16	1-2-7-0	1-2-5-7	1-2-5-9 <6><5><4>	Adjust Mode
V17	8-2-7-0	8-2-5-7	8-2-5-9 <6><5><4>	Adjust Mode
VZ9/V18/V19	0-1-7-0	0-1-5-7	0-1-5-9 <6><5><4>	Adj. Mode/0-1-8-8
V20/VK20	2-2-7-0	2-2-5-7	2-2-5-9 <6><5><4>	Adjust Mode
V21	2-1-7-0	2-1-5-7	2-1-5-9 <6><5><4>	2-1-8-8
K20/V22/V23	0-3-7-0	0-3-5-7	0-3-5-9 <6><5><4>	Adj. Mode/0-3-8-8

Service Menu Access Codes

Chapter 1
Disassembly and Service

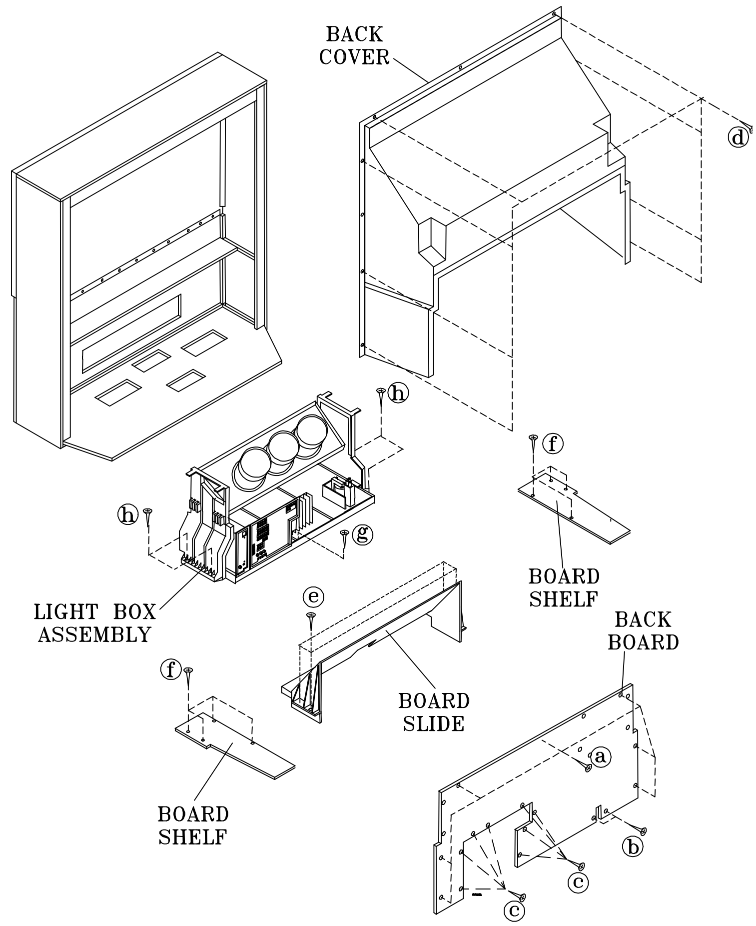


Figure 1-1: Lightbox Removal - 48" Models

With 11 different models, mechanical features and disassembly procedures vary in the V23. Since all features and disassembly procedures are in the Service Manual, this chapter will only provide a general discussion.

The V23 has the following mechanical features:

- Removable Lightbox
- Two piece cabinet (65" & 73" models)
- Customer Removable DiamondShield™
- Composite Cabinet Back (V23+++)

Lightbox

Like previous Mitsubishi projection TV chassis, the V23 is based on a modular design that allows the "lightbox" to be removed for service. Even without the front control panel, card reader or front inputs, it is still fully functional by use of the remote control. This allows easier access to test points, etc. And, when "shop service" becomes necessary, this design has several more benefits.

- No lifting of heavy, bulky cabinets
- No cabinet or screen damage.
- Less customer inconvenience.

The lightbox removal procedure for 48” V23 models is shown in *Figure 1-1*.

1. Remove the Back Board by removing 7 screws (a), 2 screws (b) and 8 screws (c).
2. Remove the Back Cover by removing 8 screws (d).
3 Remove 4 screws (e) to remove the Board Slide.
4. Remove 8 screws (f) to remove the Board Shelves.
5. Remove screw (g) holding the chassis.
6. Remove 4 screws (h) securing the Light Box Assembly.
7. Be certain that all cables and connectors between the Light Box Assembly and external items are disconnected (e.g. speaker plugs, etc.), including the USB and IEE1394 connectors from the Card Reader to the DM.
8. Slide the Light Box Assembly from the cabinet.

The procedure is similar for all models. The 48” versions do **not** require the removal of the black plastic Back Cover. Refer to the Service Manual for specific disassembly instructions on all models.

> NOTE: When V19, V21 and V23 models are first plugged in, the front panel LED will flash for about 1 minute indicating the “boot time” required before the Power On command will be recognized. In addition, V23 models have a “Energy Mode,” If set to Low, the 1 minute boot time does not start until after the Power on command is given. If the lightbox is being serviced without the front panel, no indication of these requirements will be present.

Although not required, for the reasons noted, it is usually better to have the front panel connected when servicing the lightbox. If this is not possible, the following power up sequence should be used:

1) Apply AC power.
2) Press the remote Power button once.
3) Wait 90 seconds.
4) If no response, press the Power button again.
5) Wait 90 seconds.

Main Chassis Removal

Refer to *Figure 1-2* to remove the Main Chassis.

1. Undo the cable wire ties to the Front Panel, Speakers, CRTs, etc.
2. Unplug the Card Reader USB and 1394 cables from the DM module.
2. Remove screw (a) securing the Main Chassis [and screws (b) in models WS-55813 and WS-65813] .
3. Release the Chassis Locks on each side of the chassis.
4. Slide the Chassis out the rear of the unit.
5. Tilt upward to access the bottom of the main chassis.

DM Replacement

Refer to *Figure 1-3* to replace the DM assembly.

1. Unplug the Card Reader USB and 1394 cables from the DM module, and refer to the Chassis Removal Procedure to slide the chassis towards the rear of the set.
2. Remove screws (a), to remove the DM Rear Panel, *Step 1*.
3. Remove screws (a) and (b) to remove the DM Module Cover, *Step 2.*
3. Remove the E2P module from the original DM and plug it into the replacement DM.
5. Plug the DM module securely into the PCB-DTV-TUNER.
6. Check operation before installing the DM Cover, *Step 3.*
    - Insert insulation (cardboard) between the Demodulator Ground Spring and the DM.
    - Plug the set in and check the operation.
    - If O.K., unplug the set and install the DM Cover.

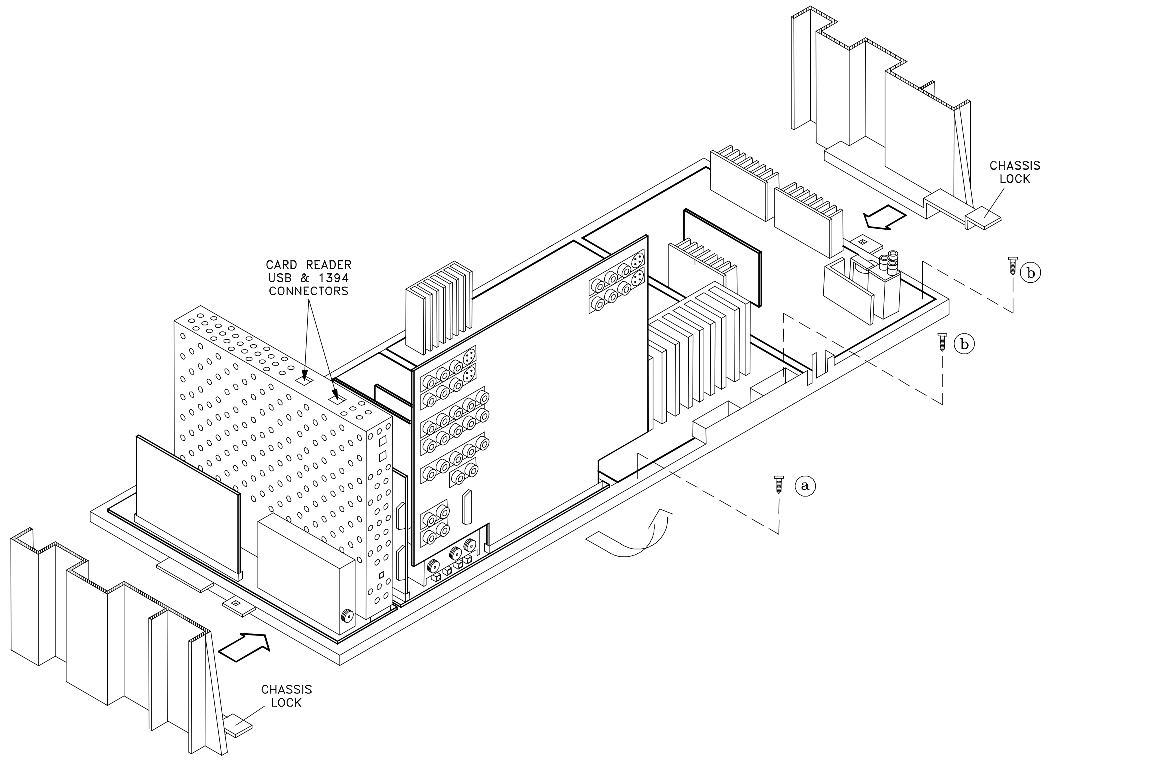


Figure 1-2: Main Chassis Removal

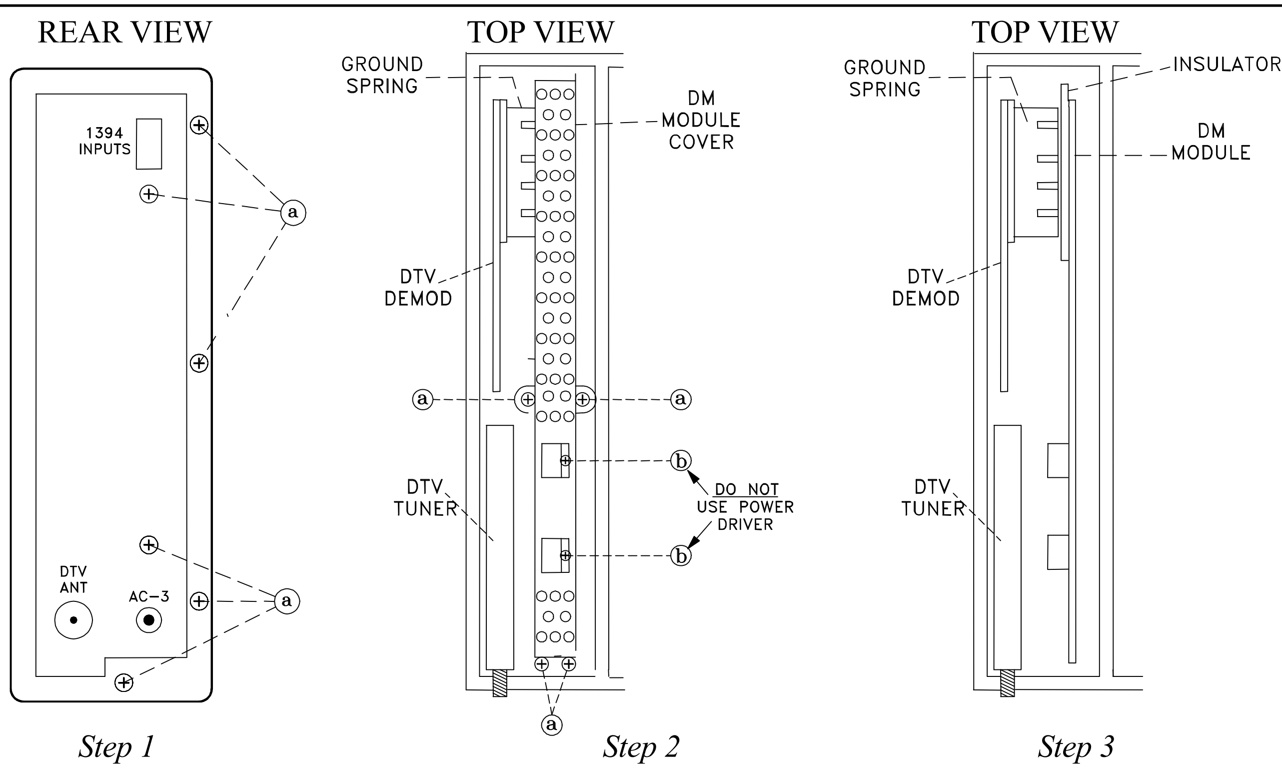


Figure 1-3: DM Replacement

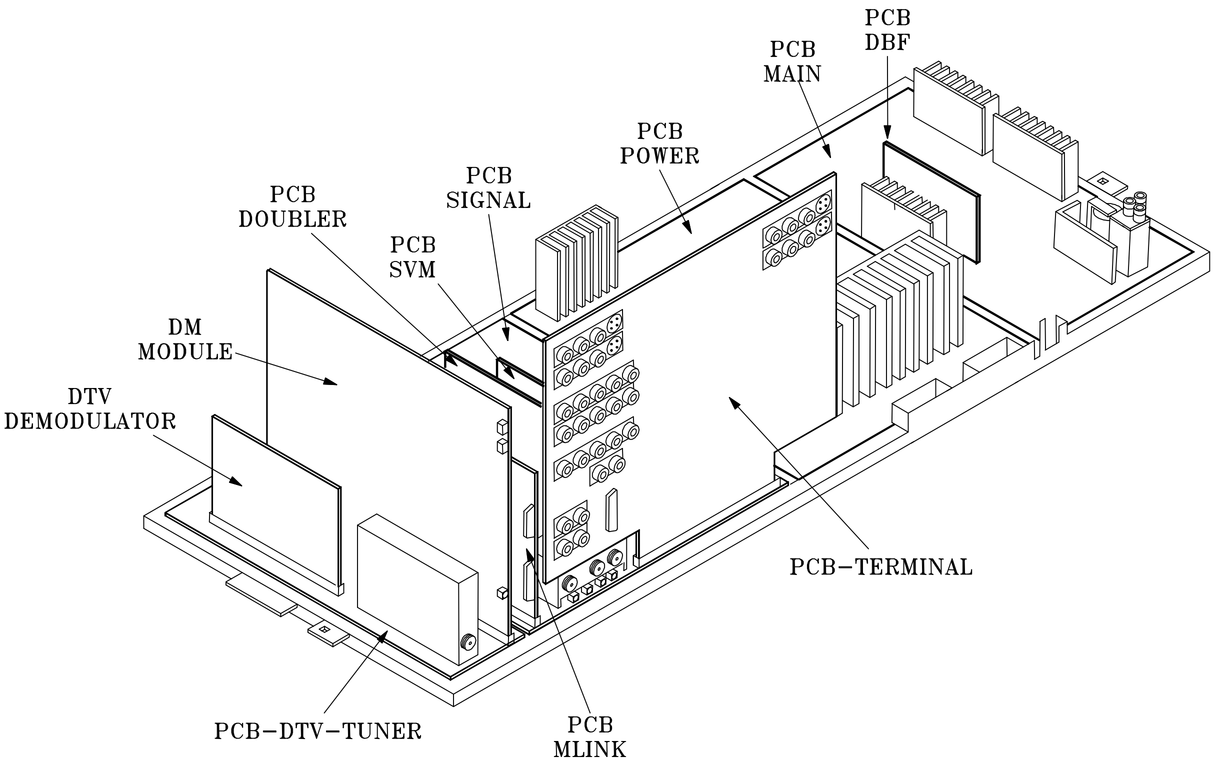


Figure 1-4: PCB Locations

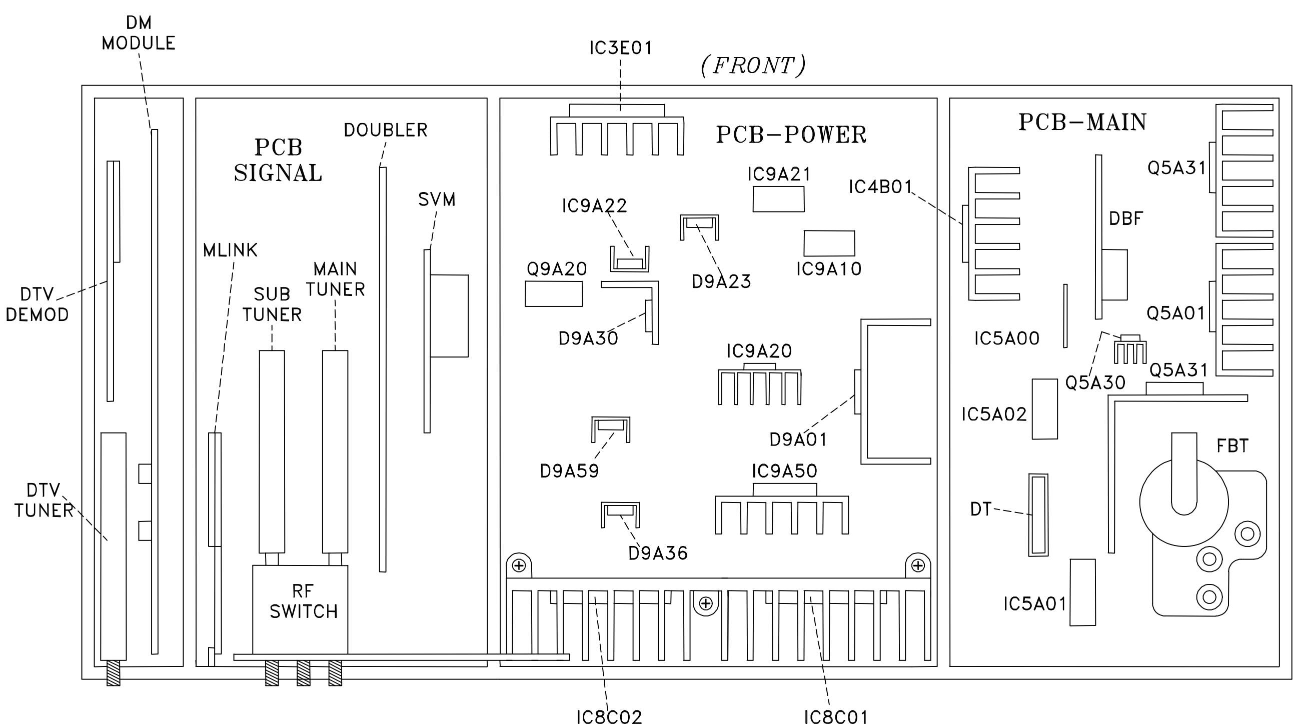


Figure 1-5: Main Component Locations

PCB-DTV Tuner	DM	PCB-MLINK	PCB-Terminal	PCB-Signal
IR Learning	NetCommand	DVI Decoder	A/V Inputs	Control uPC
DM Interface	IEEE1394	RS-232C Interface	A/V Selection	Tuning
DTV Tuner & Demodulator Interface	Card Viewer		3D-Y/C	VCJ
	OSD-Menus		NTSC Video Decoders	Convergence Generator
	Digital uPC Control			

PCB-Doubler	PCB-SVM	PCB-Power	PCB-Main	PCB-DBF
PIP-POP	Scan Velocity Modulation (Picture Edge Enhancement)	Power Supplies	Horizontal Defl.	Dynamic Beam Forming (Corner Focus)
Picture Format		Audio Amp.	Vertical Defl.	
3:2 Pull Down		Convergence Amps.	High Voltage	
Line Double 480i to 480p				

Table 1-1: PCB Functions

PCB & Major Component Locations

PCB and major component locations are shown in *Figures 1-4 and 1-5.* The major circuit functions performed on each PCB is listed in *Table 1-1*.

Convergence IC Replacement

To maximize cooling efficiency, the Convergence Amplifier ICs, IC8C01 & IC8C02, are mounted as close to the back cover vents as possible. With the heat sink fins over the top of the IC, access for replacement is restricted. To simplify replacement use the following procedure to remove the heat sink.

1) Release the 2 spring clips from the rear (towards the front of the set) of the heat sink.
2) Remove the 3 mounting screws shown in *Figure 1-6*.
3) Remove the heat sink by gently prying the IC's loose.

When reinstalling, please note:

- Overtightening the screws can strip the plastic threads in the chassis.
- Mounting clips should be firmly seated for proper heat transfer.

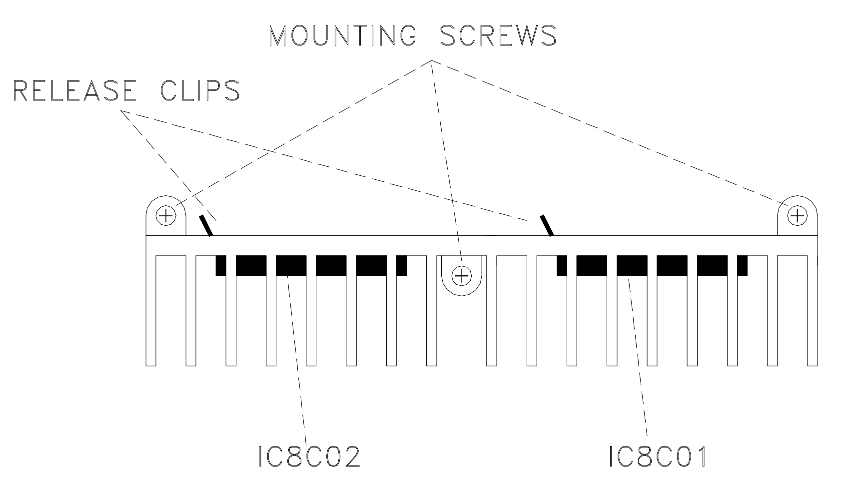


Figure 1-6: Convergence IC Removal

V23+++ Composite Cabinet Back

The WS-55813 and WS-65813 feature a unique cabinet similar to last year's WS-65712. It has a composite cabinet back that offers several advantages.

- Rounded edges in the back have a modern appearance.
- Unit construction gives it high strength.
- Low Weight - The 55" version is about 50 lbs lighter and the 65" version is about 100 lbs lighter than comparable models!

The disassembly procedure for the cabinet front differs from conventional cabinets. Note how the Cosmetic Front Panel is removed. Refer to *Figure 1-7*.

1. Remove the Speaker Grille by pulling forward.
2. Remove 2 screws (a) securing the Cosmetic Front Panel.
3. Slide the Cosmetic Front Panel 1 inch to the right, then lift away from the TV.
4. Remove 6 screws (b) to remove the Board Front.
5. Unplug the LF connector.
6. Remove the 4 screws (c) securing the Screen Assembly.
7. Lift the Screen Assembly up and away from the cabinet.

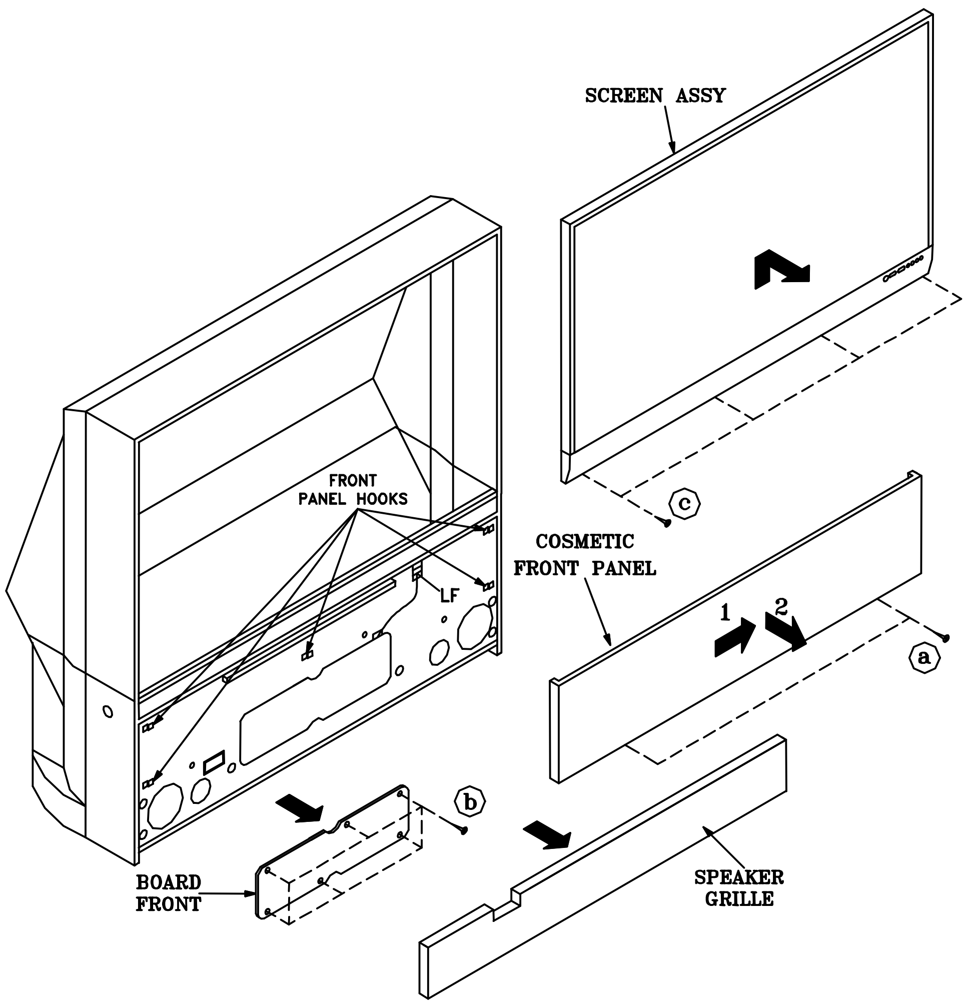
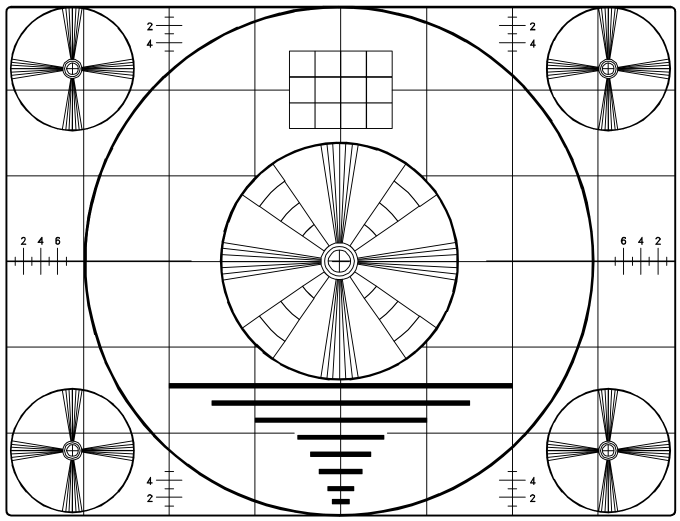


Figure 1-7: V23+++ Cabinet Front Disassembly

Chapter 2
Alignment Procedures



With the exception of the Service Menu access codes, the general alignment procedures for the V23 chassis remains the same as previous HD chassis. A chart showing all recent Service Menu Access Codes is provided on page 12 of the Introduction. This chapter will give an overview of the following alignment procedures.

- Initial Setup - Option Menu
- Circuit Adjustment Mode
- Convergence Adjustment Mode
- Alignment Data Storage Locations

For specific alignments, refer to the Service Manual.

Initial Setup

Option Menu - Initial Setup

Prior to alignment, the procedures for initial setup should be followed so that all customer Main Menu and A/V settings are set to the factory defaults listed in *Table 2-1* and *Table 2-2*.

Follow the steps below for the initial set-up:

1) Select the "MENU" display by pressing the "MENU" button once.
2) Press the number buttons "0", "3", "7", "0" in sequence to select the "OPTION MENU" display. See *Figure 2-1*.
3) Press the "ADJUST" button to select "INITIAL."
4) Press "ENTER."
   NOTE: At this time, all Main Menu and A/V settings will be set to the factory default settings and channel 3 will be automatically selected.

(MENU-0-3-7-0)

OPTION MENU
Initial
Power restore :OFF
DTV Port :Auto

Figure 2-1: Option Menu

MAIN MENU DEFAULT SETTINGS

SETUP	
Edit Setup	
Review	
Antenna A	(v) Enabled
Antenna B	(v) Enabled
Input DTV	(v) Enabled
Input 1	(v) Enabled
Input 2	(v) Enabled
Input 3	(v) Enabled
Component 1	(v) Enabled
Component 2	(v) Enabled
Antenna DTV	(v) Enabled
VGA	(v) Enabled
MonLink	(v) Enabled
Card 1	(v) Enabled
Card 2	(v) Enabled
Card 3	(v) Enabled
Card 4	(v) Enabled
Icon Position	As above
Ant-A, Ant-B, Ant-DTV, ComFlash MemStick, SmartMed, MMC& SD Input-1, Input-2, Input-3, Comp-1, Comp-2, Input DTV, VGA, MonLink, Cards 1…4	
Transport Menu	On
Energy Mode	Standard
Language	English
ANTENNA	
Antenna	ANT A
Memorize Channels	Air
Channel	Ch-3
Memory	Deleted

TIME	
Clock Setting	Manual
Time	12:00 AM
Day	Monday
CAPTIONS	
Analog Captions	With Mute
Background	Gray
Digital Captions	With Mute
Digital Settings	
Appearance	Default
Digital Channel Guide	Off
V-CHIP LOCK	
V-CHIP	Off
TV Rating	TV-PG
FV-Fantasy Violence	(v) Enabled
D-Sexual Dialog	(v) Enabled
L-Adult Language	(v) Enabled
S-Sexual Situation	(v) Enabled
V-Violence	(v) Enabled
Program not Rated	(v) Enabled
Movie Rating	PG
V-Chip Time	
Start Time	12:00 AM
Stop Time	12:00 AM
Lock By Time	
Lock by Time	Off
Lock Time	NA
Unlock Time	NA
Front Button Lock	Off
AUDIO/VIDEO SETTINGS	
A/V Memory Reset	Ant-A

Audio	
Volume	30%
Bass	50%
Treble	50%
Balance	50%
Surround	Off
Listen to	Stereo
Level Sound	Off
TV Speakers	On
Audio 2 Out	Main
Video	
Contrast	100%
Brightness	50%
Sharpness	50%
Color	50%
Tint	50%
Color Temp.	High
Video Noise	Standard
Image Type	Video
VSM Sharpness	On
Video Mute	On
Black Enhancement	On
Advanced	
Color Balance	Manual
PerfectColor™	Centered
PIP/POP	
Source	Ant A Ch 3
PIP Position	Lower Right
POP Position	Right Half
PIP/POP Format	2 Window
Format	Stretched

Table 2-1: Main Menu Factory Defaults

A/V RESET DEFAULT SETTINGS (By Input)

A/V Memory	Ant A/B	Ant DTV	Inp-DTV	INPUTS 1/2/3	Compon. 1/2	VGA	1394 1/2/3	MonLink	Card 1~4
Contrast	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.
Brightness	Center	Center	Center	Center	Center	Center	Center	Center	Center
Sharpness	Center	Center	Center	Center	Center	N/A	Center	Center	Center
Color	Center	Center	Center	Center	Center	Center	Center	Center	Center
Tint	Center	Center	Center	Center	Center	Center	Center	Center	Center
Color Temp.	High	High	High	High	High	High	High	High	High
Video Noise	Standard	N/A	Standard	Standard	Standard	N/A	N/A	Standard	N/A
Image Type	Video	N/A	Video	Video	Video	N/A	N/A	Video	N/A
VSM Sharpness	On	On	On	On	On	On	On	On	On
Bass	Center	Center	Center	Center	Center	Center	Center	Center	Center
Treble	Center	Center	Center	Center	Center	Center	Center	Center	Center
Balance	Center	Center	Center	Center	Center	Center	Center	Center	Center
Surround	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Listen To	Stereo	English	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Level Sound	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Table 2-2: A/V Default Settings

Circuit Adjustment Mode

Most of the adjustments can only be performed using the remote hand unit. See *Figure 2-2*. Many of the adjustments must be performed in both the 480i and 1080i modes. Video/Color adjustments must be performed in the 480i and 1080i modes, and data must be preset in the 480P (DVD) and VGA modes.

> **Note:** Set the Remote Operational Mode to "NetCommand". (Hold the "Power" button and press "9-3-5" in sequence.) This slows the remote's response and makes adjustments easier. When adjustments are complete, **set the Remote to its' original Operational Mode.** (Hold the "Power" button and press "0-0-0" in sequence)

Activating the Circuit Adjustment Mode

The current signal source determines if the activated Adjustment Mode is 480i or 1080i.

1. Select the signal source (480i or 1080i).
2. Press the "MENU" button on the remote control so the Main Menu is displayed.
3. Press the number buttons "0", "3", "5", "7" in sequence. The screen will change to the Circuit Adjustment Mode. See *Figure 2-3*.

Note: Repeat steps 2 and 3 if the circuit adjustment mode does not appear on screen.

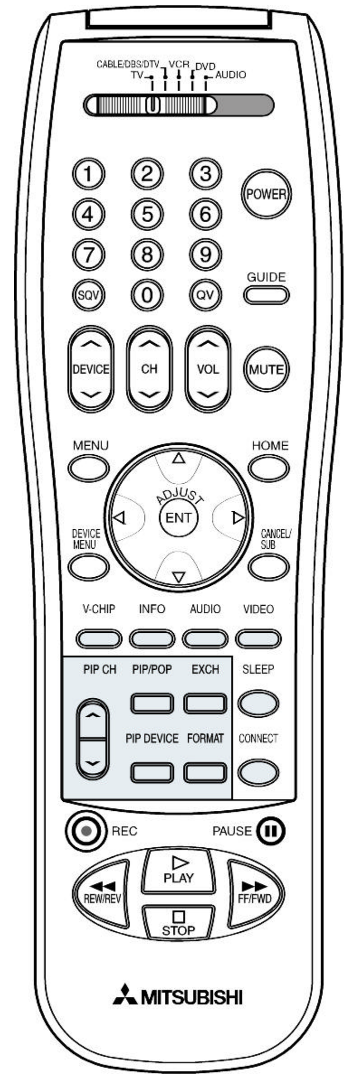


Figure 2-2: Remote Control

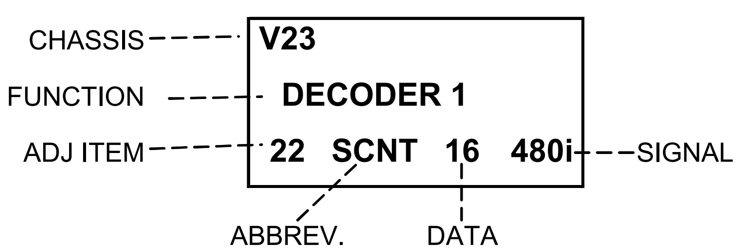


Figure 2-3: Circuit Adjustment Mode

Selection of adjustment Functions and Adjustment Items

To select an adjustment item in the circuit adjustment mode, first select the adjustment function that includes the specific adjustment item to be selected. Then select the adjustment item. Refer to the following pages for the listing of adjustment functions and adjustment items.

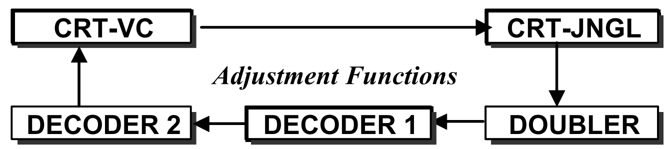


Figure 2-4: Adjustment Functions

1) Press the "AUDIO" button on the remote hand unit to select an adjustment function. Each time the button is pressed, the Function changes in the sequence shown in *Figure 2-4*.
2) Press the “VIDEO” button to select a specific Adjustment Item. The Item number increases each time the “VIDEO” button is pressed.

Changing Data

After selecting an adjustment Item, use the “ADJUST UP/DOWN” buttons to change data.

- Press “ADJUST DOWN” to decrease the data value.
- Press “ADJUST UP” to increase the data value.

Saving Adjustment Data

Press “ENTER” to save adjustment data in memory. The character display turns red for approximately one second in this step.

> **Note:** If the circuit adjustment mode is terminated without pressing “ENTER”, changes in adjustment data are not saved.

Terminating the Circuit Adjustment Mode

Press the “MENU” button on the remote hand unit twice to terminate the adjustment mode.

> **Note:** The circuit adjustment mode can also be terminated by turning the power OFF.

Toggle Between Reception Modes

Pressing “3” when in the Adjustment Mode, CRT-VC Function toggles between 480i, 480p, 1080i and VGA. However, data changes are not automatically saved. **Press “ENTER” to save data before pressing “3”**.

NEW FEATURE… **Service Mode Reset**

To reset items in the Service Mode to their original factory adjusted values:

1) Press MENU-0-3-5-7 to enter the Service Mode.
2) Press “0-1-2-3,” in sequence to Reset to the Factory settings.

On Screen Display Position Adjustment Mode Activation

1) Select 480i or 1080i source.
2) Press MENU-0-3-8-8

Convergence Adjustment Mode

The Convergence mode is used to perform raster geometry correction and convergence adjustments. **These adjustments must be made in both the SD (NTSC 480i) and HD (1080i) modes.**

> **Note:** Before activating the Convergence mode, turn "Video Mute" Off. The internal crosshatch pattern will not be displayed with "Video Mute" On, only a blue background is displayed.

Convergence Mode Activation

1. Press MENU-0-3-5-9
2. When the Convergence Mode is activated, this display appears on a Green Crosshatch. See *Figure 2-5*.

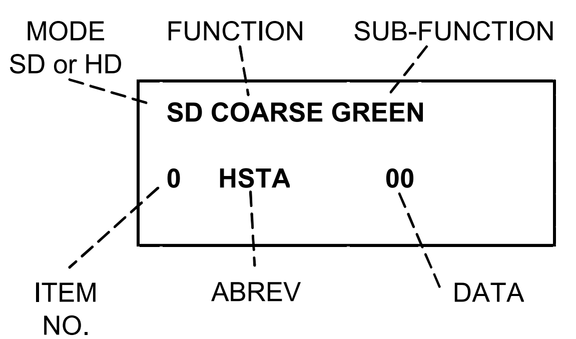


Figure 2-5: Convergence Mode

Selecting the HD or SD Mode

1. **Select the Signal Source** before entering the Convergence Mode, either an NTSC or HD source.
2. **Enter the Convergence Mode**
   - If the signal source is NTSC, the SD mode is activated.
   - If the signal source is HD, the HD mode is activated.
3. **Activating the HD mode when no HD signal is available**
   - Press the "DEVICE" button.
   - Use the "UP-DOWN-RIGHT-LEFT" direction buttons to select ANT-DTV, then press "ENTER".
   - Press "MENU-0-3-9-5" in sequence to activate the Coarse Green HD Convergence mode.

Convergence Mode Functions

In the Convergence Mode there are three main Functions (Categories).

- Pressing "6" activates CONV MISC
- Pressing "5" activates COARSE CONV
- Pressing "4" activates FINE CONV

CONV MISC (Press 6)

This mode is used to preset data values controlling the Convergence Generator, and to perform the HV Regulation adjustment.

1) Use the VIDEO button to select an item.
2) Use the ADJUST buttons to change data.

> **NOTE:** When Item "1 HVOL" is selected the screen goes black except for the data display. This occurs since a black screen is required when making the HV Regulation adjustment.

COARSE CONV (Press 5)

There are four Sub Functions in the Coarse mode, COARSE GREEN, COARSE RED, COARSE BLUE and DF.

- COARSE GREEN .... used to make Coarse Raster Geometry Adjustments.
- COARSE RED ... used to make Coarse Red Convergence Adjustments.
- COARSE BLUE ... used to make Coarse Blue Convergence Adjustments.
- DF ... used to preset data values controlling the Dynamic Beam Focus circuit drive signal.

1) Use AUDIO button to select a Sub Function
2) Use the VIDEO button to select an Adjustment Item.
3) Use the ADJUST buttons to change data.

FINE CONV (Press 4)
This mode is used to perform Fine Raster Correction, and Fine Red and Blue Convergence Adjustments. There are three Sub Adjustment Functions, selected with the AUDIO button:

- FINE GREEN .... a Green Crosshatch is displayed, to make Fine Raster Corrections.
- FINE RED .... a White Crosshatch is displayed, to make Fine Red Convergence Adjustments.
- FINE BLUE .... a White Crosshatch is displayed, to make Fine Blue Convergence Adjustments.

In the Fine mode a Cursor is added to the Crosshatch. See *Figure 2-6*. The ENTER button toggles the Cursor between two modes:

- MOVE (blinking Cursor) .... use the ADJUST buttons to select any of 64 points on the Crosshatch.
- ADJUST (Non blinking Cursor) .... the ADJUST buttons adjust the active color at the current Cursor position, horizontally or vertically.

The on-screen display changes in the Fine mode, as shown in *Figure 2-7*. The display shows the vertical and horizontal data for the current Cursor Position, and the horizontal and vertical coordinates for that position.

Saving Data and Exiting the Convergence Mode
Press MENU twice to exit the Convergence mode. Data is automatically saved at this time.

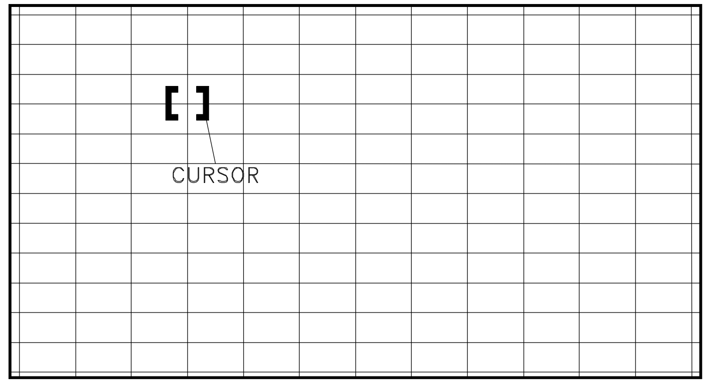


Figure 2-6: Fine Convergence Mode

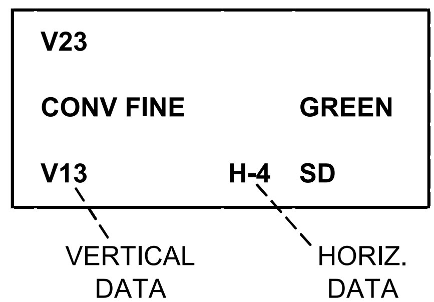
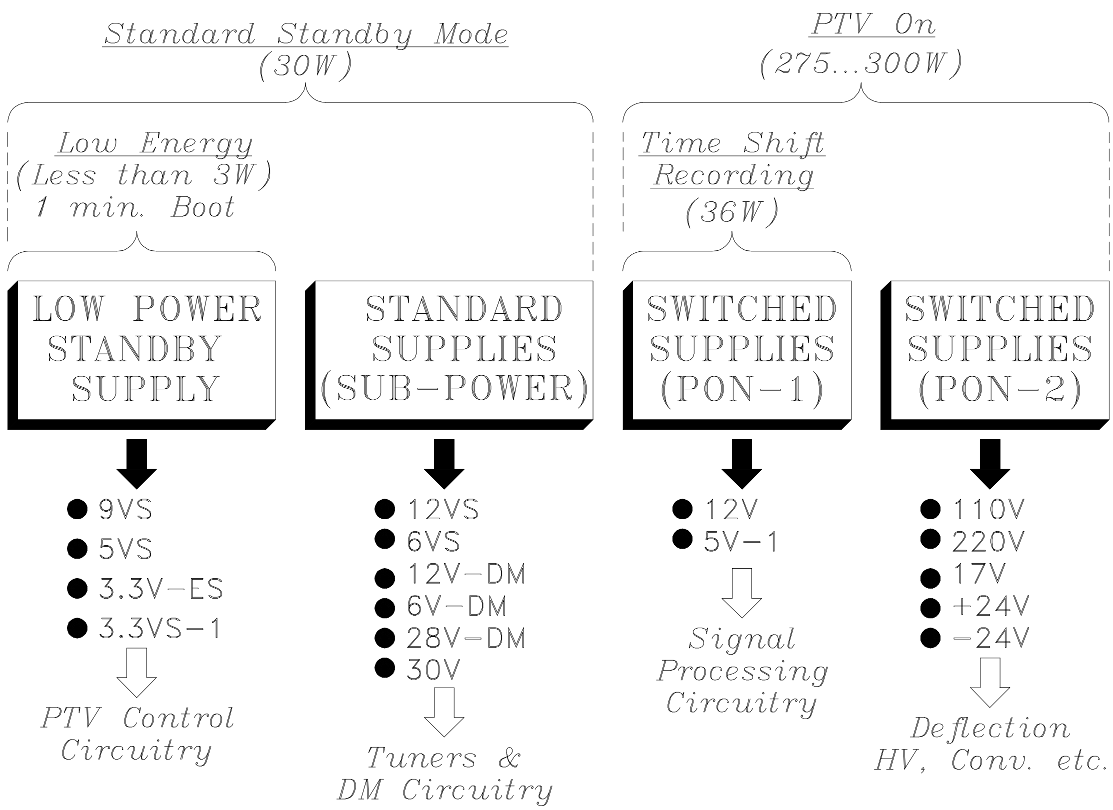


Figure 2-7: Fine Convergence

Alignment Data Storage Locations

Data accessed in the Convergence Adjustment Mode is stored in IC8D01 located on the PCB-Signal. Replacement PCB's are supplied pre-aligned so that only fine adjustments should be necessary after replacement. All other service alignment data is stored on the PCB-E2P located on the DM assembly. When replacing the DM assembly, retaining the original PCB-E2P will minimize the need for any realignment.

Chapter 3
Power Supply



From the above diagram, it is apparent that the V23 Chassis has four Power Supply Operational Modes.

1) Low Energy Mode
2) Standard Standby Supply Mode.
3) Time Shift Recording Mode.
4) Conventional PTV On Mode.

Low Energy Mode

When the Low Energy Mode is activated the TV uses less than 3 Watts while the set is Off. The Low Power Standby Supply generates a 9VS supply. Three additional supplies are derived from the 9VS supply, 5VS, 3.3V-ES and 3.3VS-1.

These supplies furnish power for the PTV Control Circuitry. This is the only circuitry active in the Low Energy Mode when the PTV is Off.

In the Low Energy Mode the set is booted up each time the TV is switched On. When switched On, the LED will flash for approximately one minute before the TV powers On.

Low Energy Mode Activation

The Low Energy Mode is activated from the user's On-screen Menus. To activate the Low Energy Mode:

1) Press "MENU".
2) Select the Setup Menu (Shown in *Figure 3-1*).
3) Use the Remote Direction Keys to activate, or deactivate the Low Energy Mode.

Low Energy Standby Regulator

Figure 3-2 illustrates the Low Energy Mode Regulator Circuitry. IC9A10 is the same is the same type of regulator used in the V20.



Figure 3-1: User Setup Menu

A 132 kHz internal Oscillator drives an internal Output FET. The signal from the FET at pin 5 of IC9A10, drives transformer T9A10. Signal from pin 10 of T9A10 is rectified, generating the 9VS supply.

The signal from pin 2 of the transformer is rectified and takes two paths:

1) To pin 1 of IC9A10, adding to an internally generated 6.3V supply.
2) Through R9A18 to the Standard Standby Regulator circuit, serving as a start-up voltage source.

For regulation a sample of the 9VS supply is fed back to pin 4 of IC9A10, via D9A14 and PC9A20.

Regulation

IC9A10 does not regulate by controlling the PWM of the oscillator signal. Under normal load, some of the 132 kHz cycles are removed and not applied to the FET. Under light loads, more of the cycles are removed, and during heavy loads few, if any cycles are removed. This is illustrated in F*igure 3-3.*

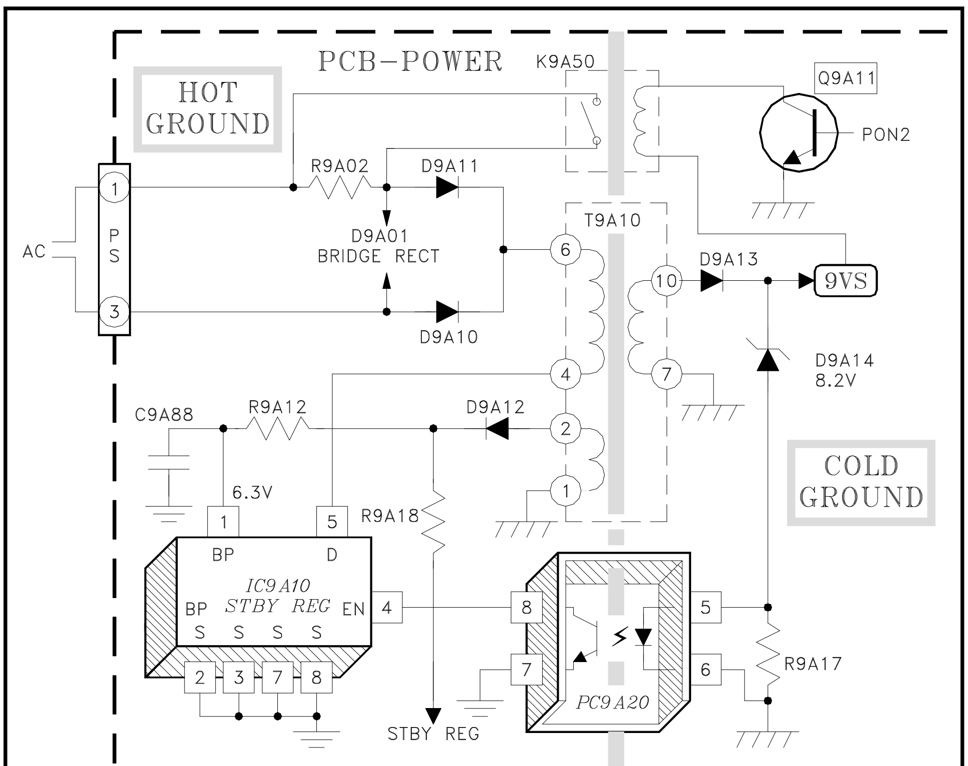


Figure 3-2: Low Energy Mode Stby Regulator

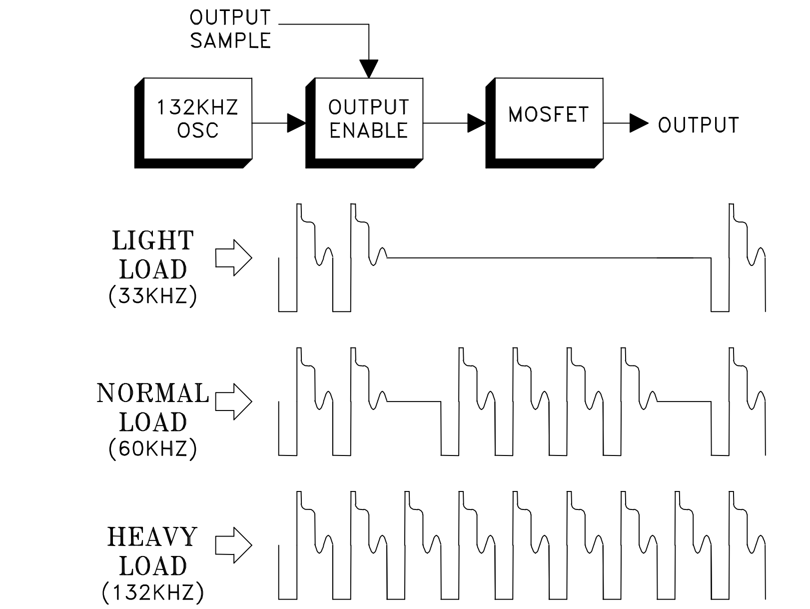


Figure 3–3: Low Energy Standby Supply Regulator

Low Energy Power Distribution

Figure 3-4 shows the Low Energy Mode Power Distribution. As stated earlier, the Low Energy 9VS is the source for the 5VS, 3.3V-ES and 3.3VS-1. The 5VS and 3.3VS-1 supplies power to the IC7A00 the PTV Control μPC.

The 3.3V-ES supplies power to the PTV Control circuit E2PROM, now located on the PCB-TERMINAL.

The 9VS supply also provides power for the Antenna Relay in the RF Switch.

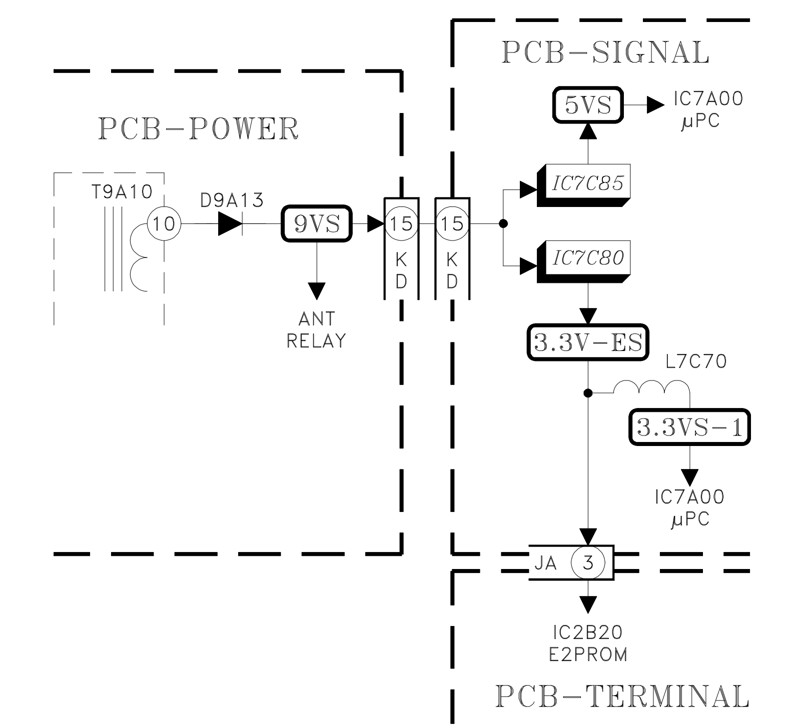


Figure 3–4: Low Energy Mode Power Distribution

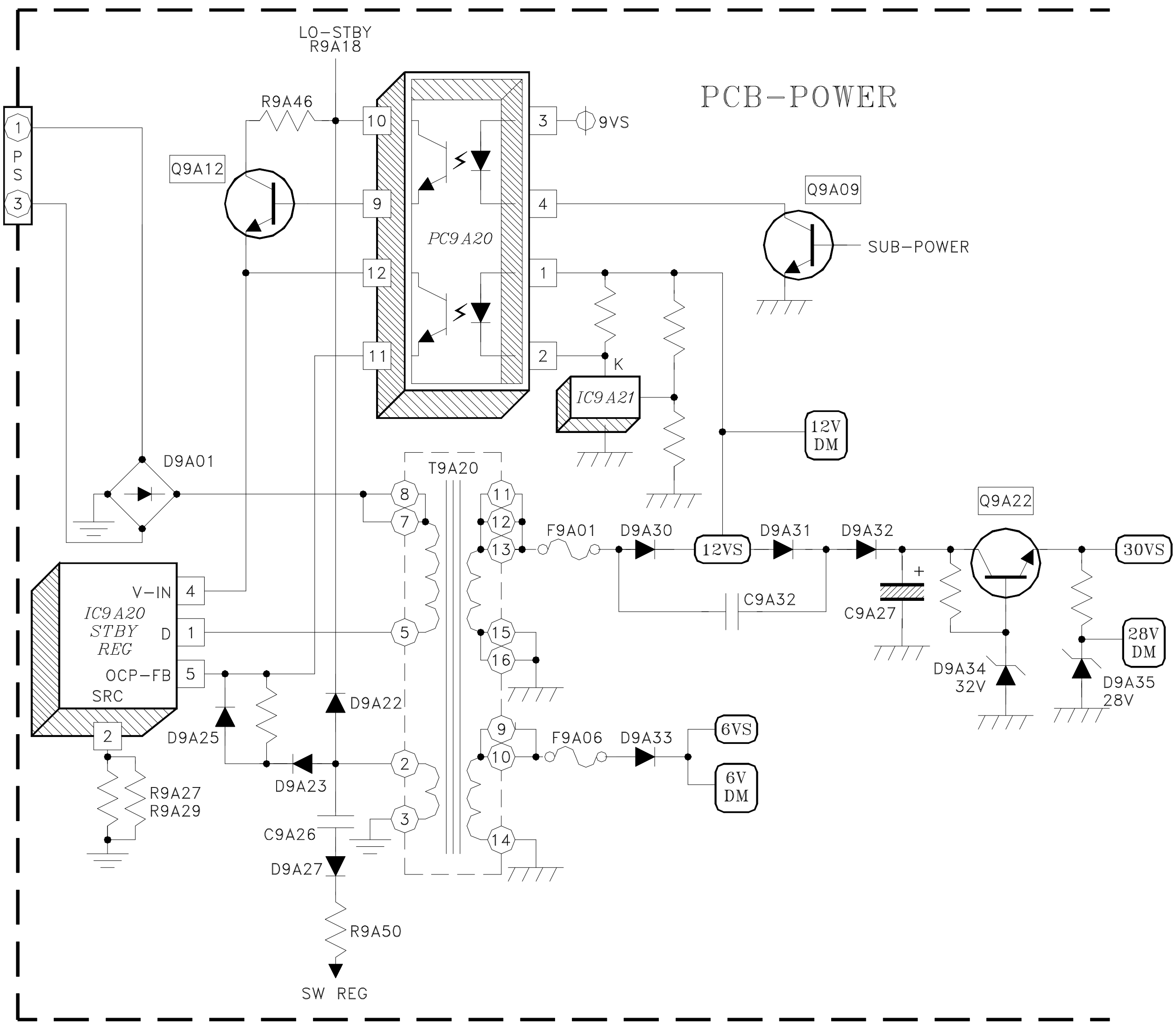


Figure 3-5: Standard Mode Standby Power Supply

Standard Standby Supply

The Standard Standby Regulator circuit is shown in *Figure 3-5*.

Start-up

The Start-up Voltage Supply is from R9A18 in the Low Energy Mode circuit, refer to *Figure 3-2*. The SUB-POWER command from the Control Circuitry activates the Standby Supply.

When SUB-POWER goes High:

- Q9A09 conducts, activating a Photo Coupler in PC9A20.
- The Photo Coupler turns Q9A12 On, supplying start-up voltage to pin 4 of IC9A20.
- When oscillation starts, the signal from pin 2 of T9A20 is rectified by D9A22 and added to the start-up voltage to maintain oscillation.

Regulation

The secondary 12VS supply is monitored for regulation. A sample of the 12VS is compared to a reference in IC9A21. A correction voltage from IC9A21 controls a second Optical Coupler in PC9A20.

The output of the Optical Coupler is applied to pin 5 of IC9A20, controlling the PWM of the oscillator's signal.

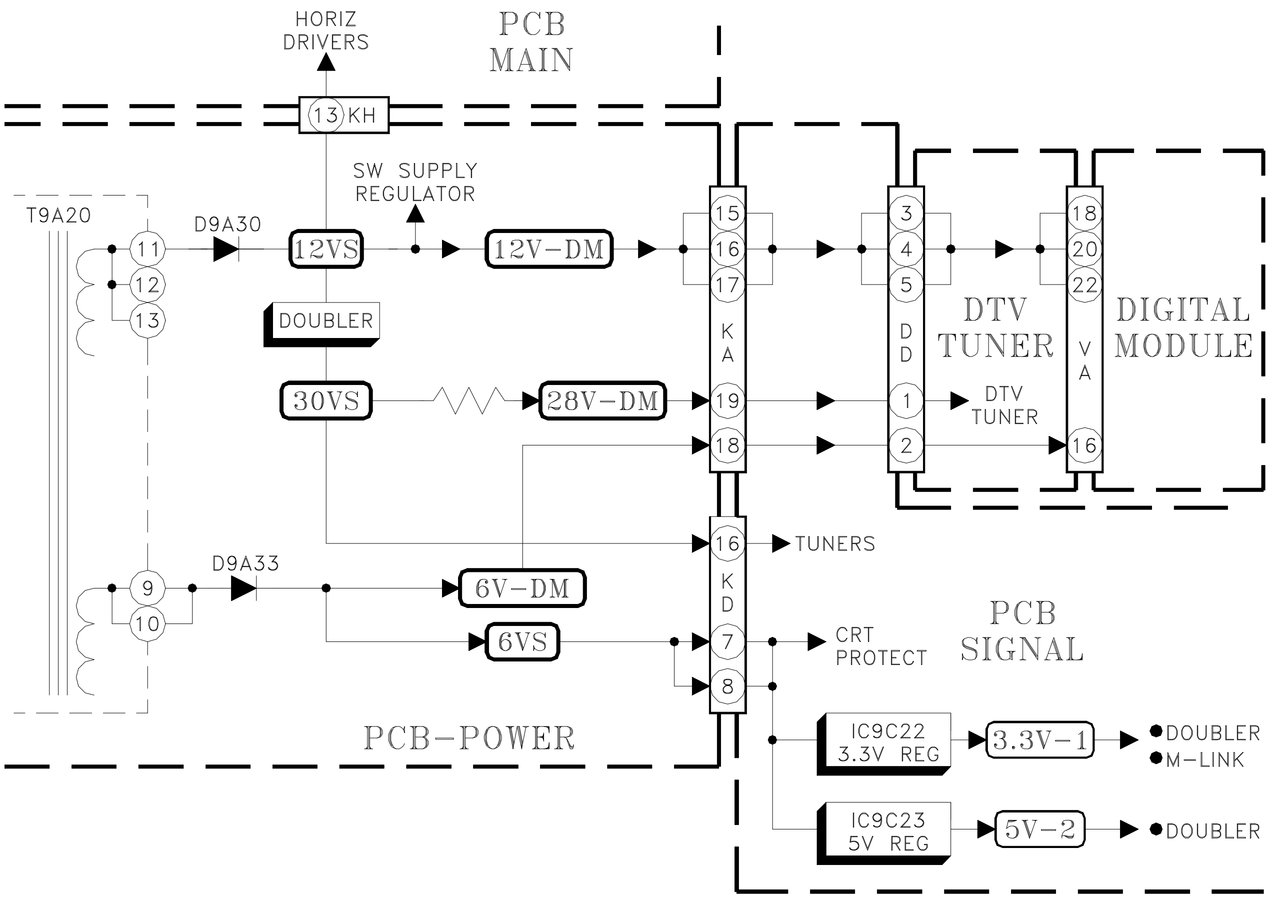


Figure 3-6: Standby Supplies Power Distribution

Standard Standby Supplies
Two Standby supplies are generated directly from T9A20, 12VS and 6VS. Both of these supplies are directed to the DM module, and are denoted as 12V-DM and 6V-DM.

A 30VS supply is derived from the 12VS source using voltage doubler circuitry, comprised of D9A31, D9A32, C9A32 and C9A27. The resulting 30VS is the source for a 28V-DM supply.

Standby Power Distribution
Figure 3-6 illustrates the Standby Power Distribution. As mentioned earlier, the 12VS is source for 12V-DM,and through the Voltage Doubler circuitry is the source for 30VS and 28-DM supplies. The 12VS is also directed to Horizontal Drive Circuitry and is the Start-up voltage source for the Switched Supply Regulator.

In addition to being the 6V-DM source, the 6VS supply supplies power for CRT Protect circuitry, and is the source for the 3.3V-1 and 5V-2 supplies.

Time Shift Recording Power Supplies.

The Time Shift Record Supplies are switched supplies derived from the Standby 12VS supply. They are activated during Time Shift Recording and when the PTV is switched On. The Time Shift Power Supply circuit is shown if *Figure 3-7.*

The supply is activated by the PON-1 command from the Control Circuitry. When Off, the PON-1 line is low, holding Q921 On, which holds Q9A20 Off by pulling its Gate low.

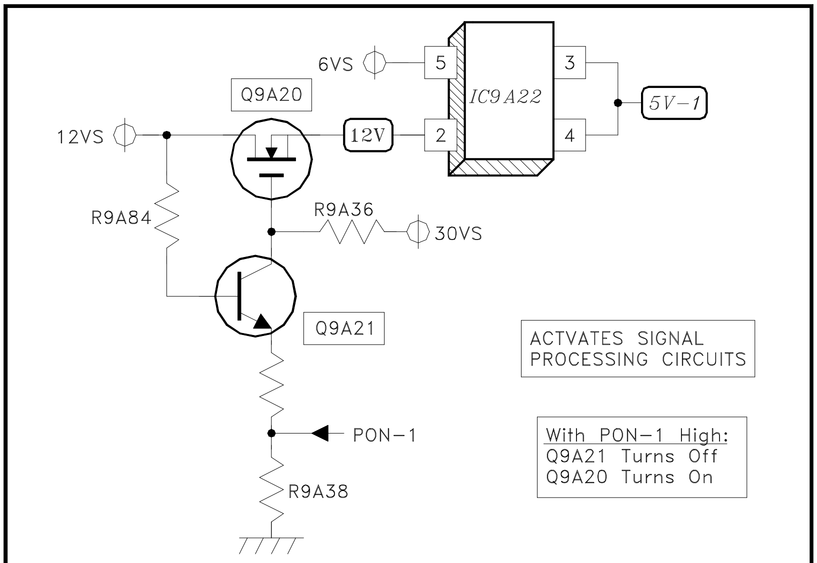


Figure 3-7: Time Shift Record Power Supply

When PON-1 goes High, Q9A21 turns Off, allowing Q9A20 to turn On. With Q9A20 conducting, the 12V supply is generated from the 12VS supply. The 12V supply enables IC9A22 and the 5V-1 supply is generated.

Time Shift Supply Power Distribution

Figure 3-8 illustrates the Power Distribution for the Time Shift supplies. The 5V-1 supply is used by the MLink, 3DYC and Signal Select circuitry. It is also the source for the 3.3V-2 supply, which is directed to the Conver-

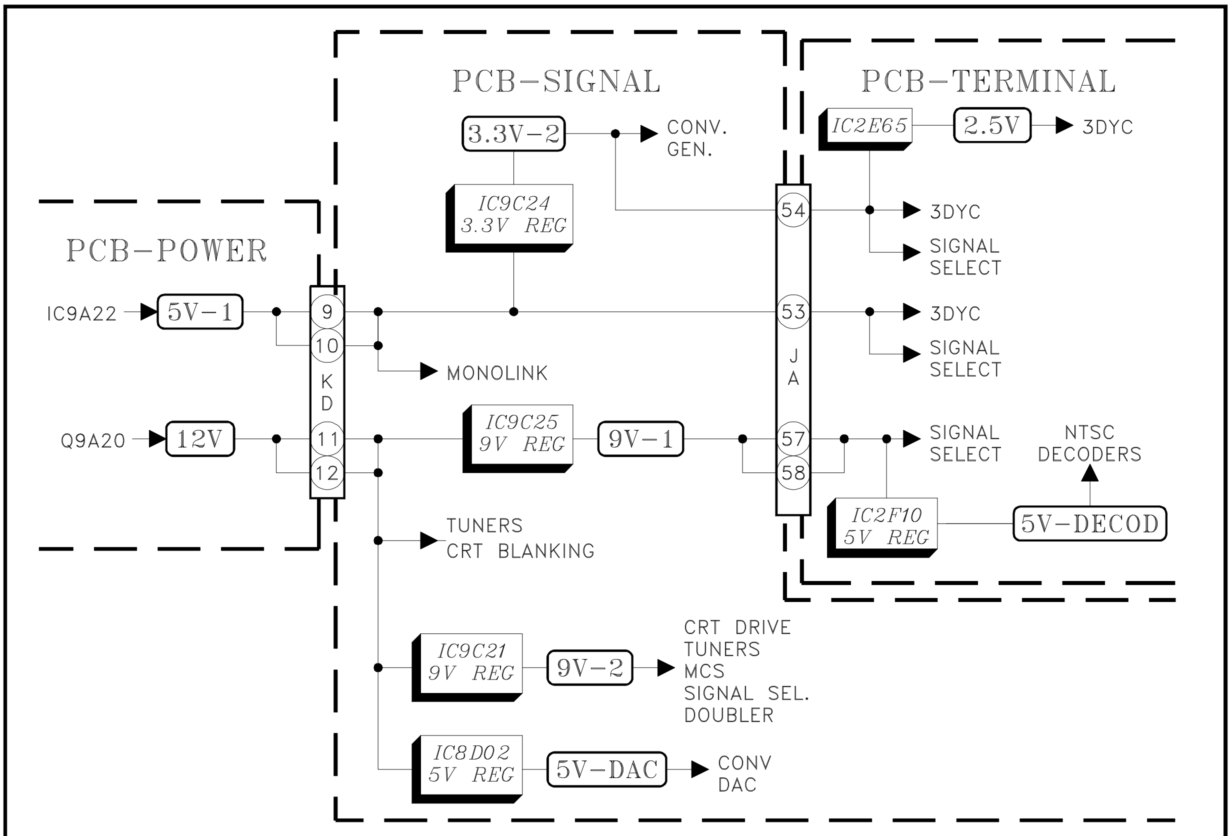


Figure 3-8: Time Shift Power Distribution

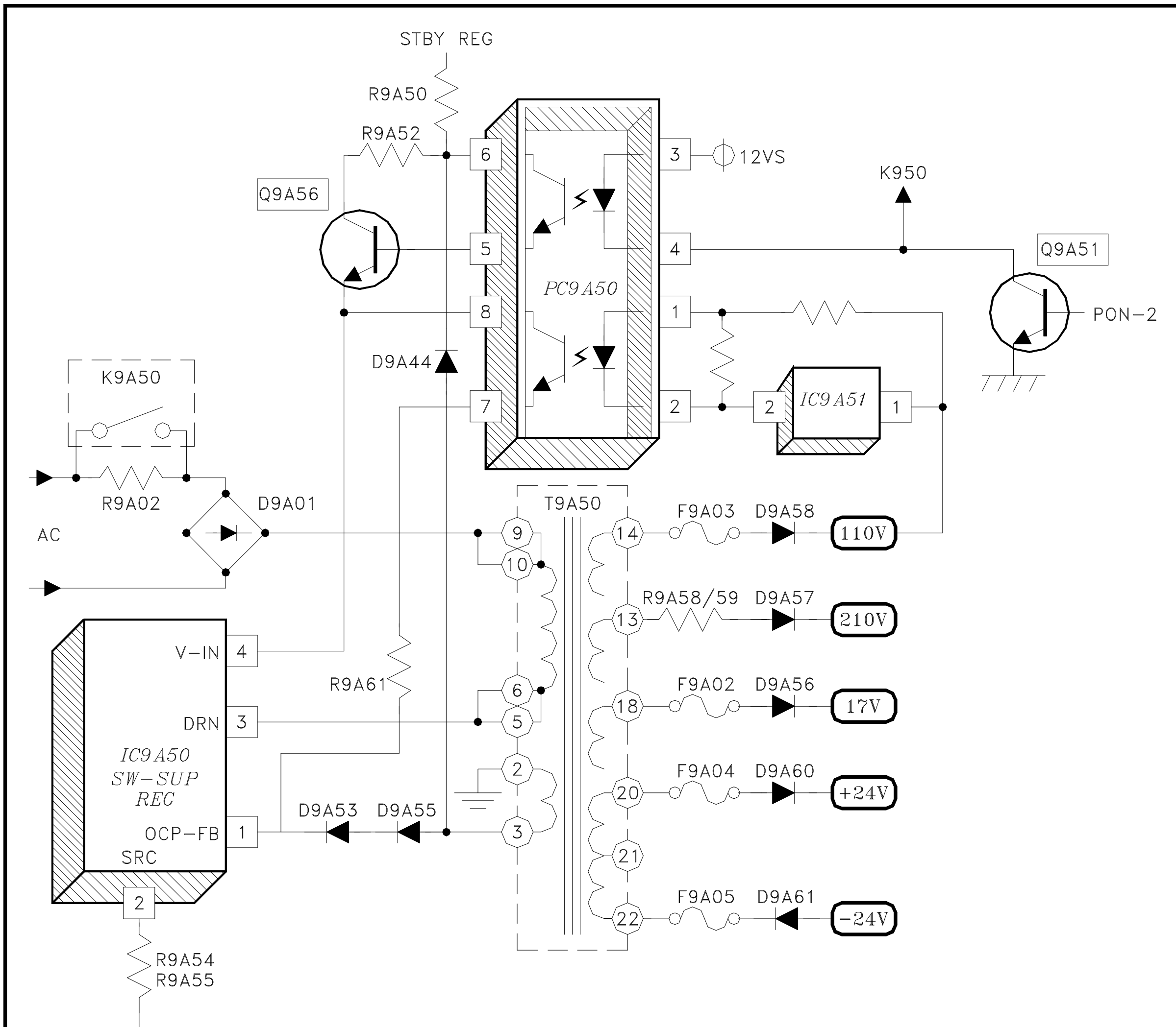


Figure 3-9: Switched Supplies Regulator

gence Generator, 3DYC and Signal Select circuitry, and to IC2E65. IC2E65 generates 2.5 Volts for 3DYC.

The 12V supply provides power for Tuners and CRT Protect circuitry. It also is the source of four additional DC Supplies:

- 9V-1 for the Signal Select circuitry
- 5V-DECOD for the NTSC Decoders.
- 9V-2 for CRT Drive, MCS, Signal Select and Doubler circuitry.
- 5V-DAC for the Convergence DAC circuits.

Switched Supplies Regulator

Figure 3-9 shows the Switched Supplies Regulator. When the TV is switched On, both the PON-1 and PON-2 lines go High. When PON-2 goes High Q9A51 conducts:

1) Closing relay K9A50, shorting out current limiting resistor R9A02, refer to *Figure 3-2.*
2) Activating a Photo Coupler in PC9A50.

The Photo Coupler turns Q9A56 On, and start up voltage from the Standby Regulator is applied to pin 4 of IC9A50.

Signal from pin 3 of T9A50 is rectified by D9A44 and added to the start up voltage to maintain oscillation.

Regulation
Regulation is achieved by monitoring the 110V secondary supply, and through IC9A51 and PC9A50 a correction voltage is fed back to pin 1 of IC9A50. The voltage at pin 1 determines the PWM (duty cycle) of

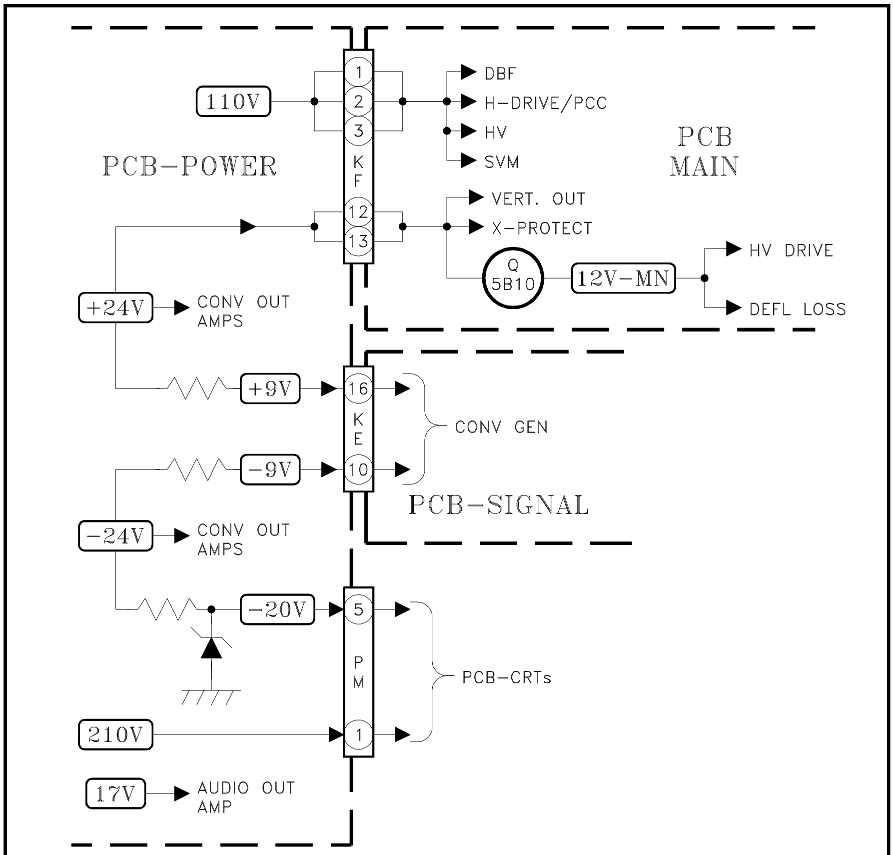


Figure 3-10: Switched Supplies Power Distribution

the oscillator drive to the FET. The PWM is automatically changed to maintain a constant 110V source.

Five supplies are directly generated by signal from T9A50, 210V, 110V, 17V, +24V and -24V.

Power Distributions

Figure 3-10 shows the Switched Supplies Power Distribution. The 110V supplies power to DBF, Horizontal Drive, HV and SVM circuitry.

The +24 source supplies power to the Vertical Output, X-Protect and Convergence circuitry. It also generates the 12V-MAIN supply that is dedicated to HV Drive and Deflection Loss circuitry.

The -24V supply is used in the Convergence circuitry, and is the source for the -20V supply used in the CRT Drive circuitry. The 210V supply is also used in the CRT Drive circuits.

Troubleshooting

The most common symptom due to Power Supply problems is "The TV Will Not Turn On". The Flow Chart in *Figure 3-11* may be of some help in isolating the cause of a "Won't Turn On Problem".

If the LED flashes:

- **For 1 minute before the TV turns On:**
  This is normal, it takes about 1 minute for the circuitry to Boot Up. Boot Up occurs the first time the TV is plugged, and if in the Low Energy mode when the Power button is pressed.

- **Flashes Continuously**
  It indicates the TV µPC is not functioning.

- **Flashes-Stops-Flashes-Stops-etc.**
  It indicates a loss of communication between the TV µPC and the DM µPC.

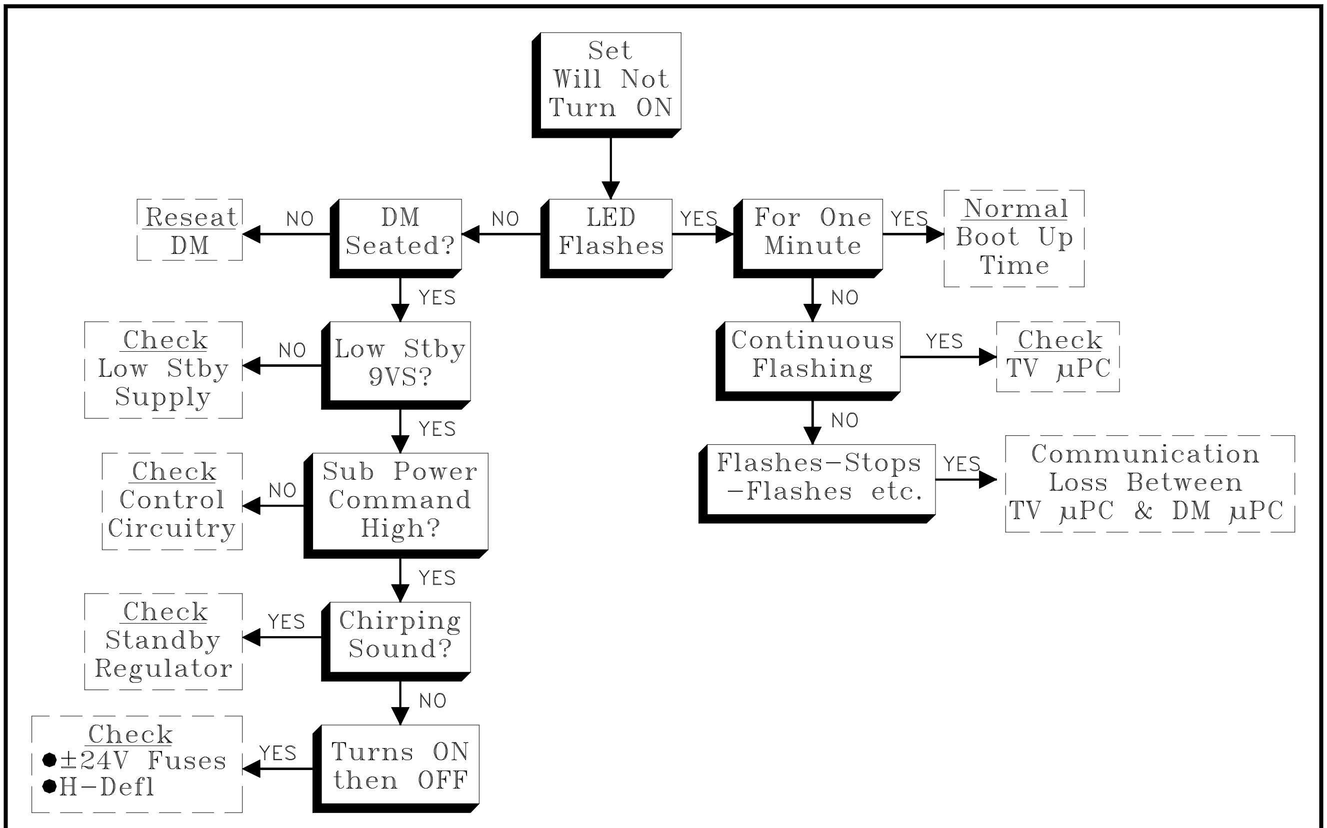
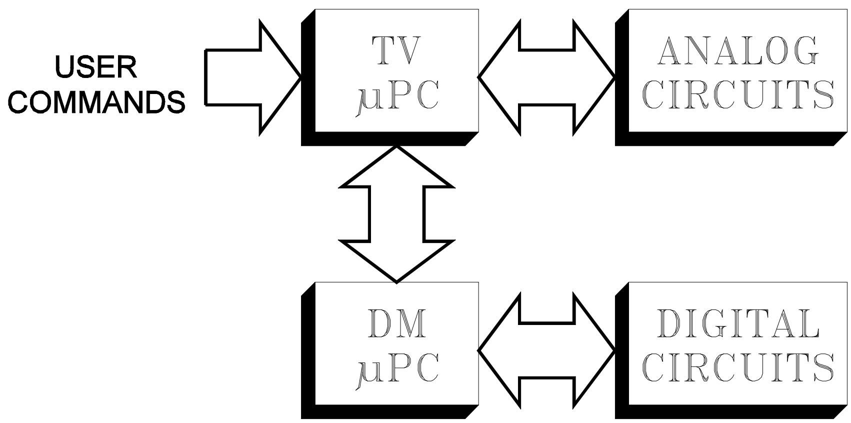


Figure 3-11: TV will not Turn ON Flow Chart

If the LED does not flash:

- Check that the DM board is seated properly.
- Check that there is Standby 9VS *(Fig. 3-2)*.
- Check that the SUB-POWER command line does not go High *(Fig. 3-5*).
- Chirping sound - check the Standby Regulator, IC9A20 *(Fig.3-5)*.
- If it Turns On then Off
  - -Check the ±24V fuses
  - -Check Horizontal Deflection Circuitry.

Chapter 4
Control Circuitry



As in the two earlier integrated HDTV chassis, V19 and V21, the V23 uses two Microprocessors in the Control circuitry.

1) TV µPC … controlling the analog circuitry.
2) DM µPC … controlling the digital circuitry.

The two µPCs constantly communicate with each other. User commands are input to the TV µPC. Digital commands are forwarded from the TV µPC to the DM µPC. The TV µPC generates Control commands from two sources.:

1) User commands from the front panel or remote control
2) Commands from the DM µPC.

Even though circuitry is becoming more complex, the same basic requirements must be met for a µPC to operate.

Basic µPC Requirements

Figure 4-1 illustrates the four basic requirements for the TV µPC operation in the V23.

1) DC Supply … 3.3V-ES and 5VS.
2) Ground Returns … pins 8, 9 and 14.
3) Timing Signal … 15 mHz Clock Oscillator
4) Reset circuitry … sets the µPC to its nominal starting point

There is similar circuitry for the DM µPC. Since the DM Module is considered a replaceable component

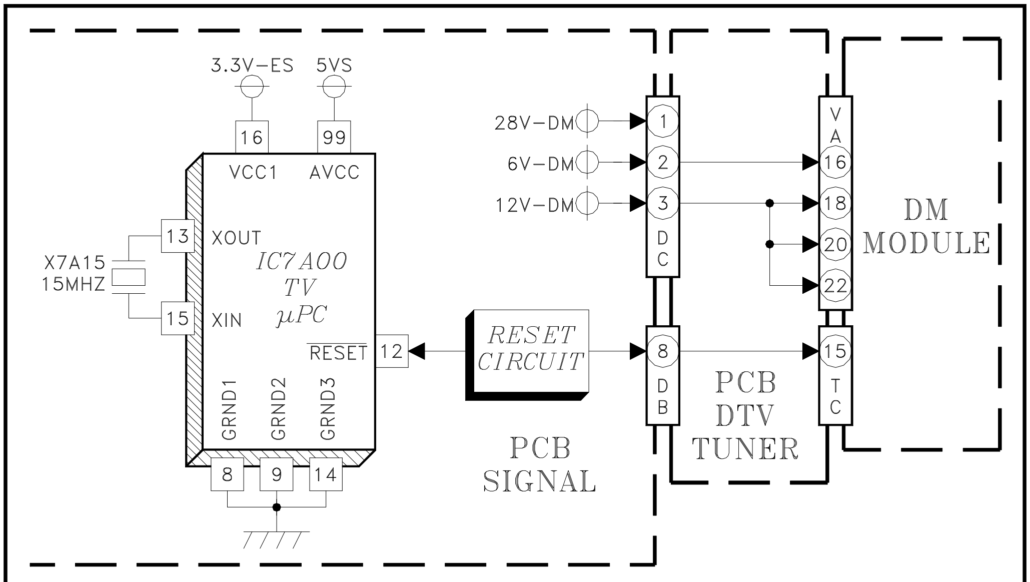


Figure 4−1: µPC Basic Requirements

we are not showing the details of the DM circuitry. *Figure 4-1* shows only the DC supplies and Reset signal going to the DM module.

Reset Circuitry

Figure 4-2 illustrates the Reset circuitry in more detail. The normal and Reset logic are shown in the diagram.

IC7C70 is the Reset IC. A Low from pin 1 resets the TV µPC. IC7C70 is a Watch Dog type of Reset IC that monitors the µPC's operation. It has an internal counter that is continually reset by pulses from the µPC, input at pin 4 of the IC. If the µPC locks up, no pulses are generated. The counter reaches its maximum count and a reset pulse is output at pin 1 to reset the µPC.

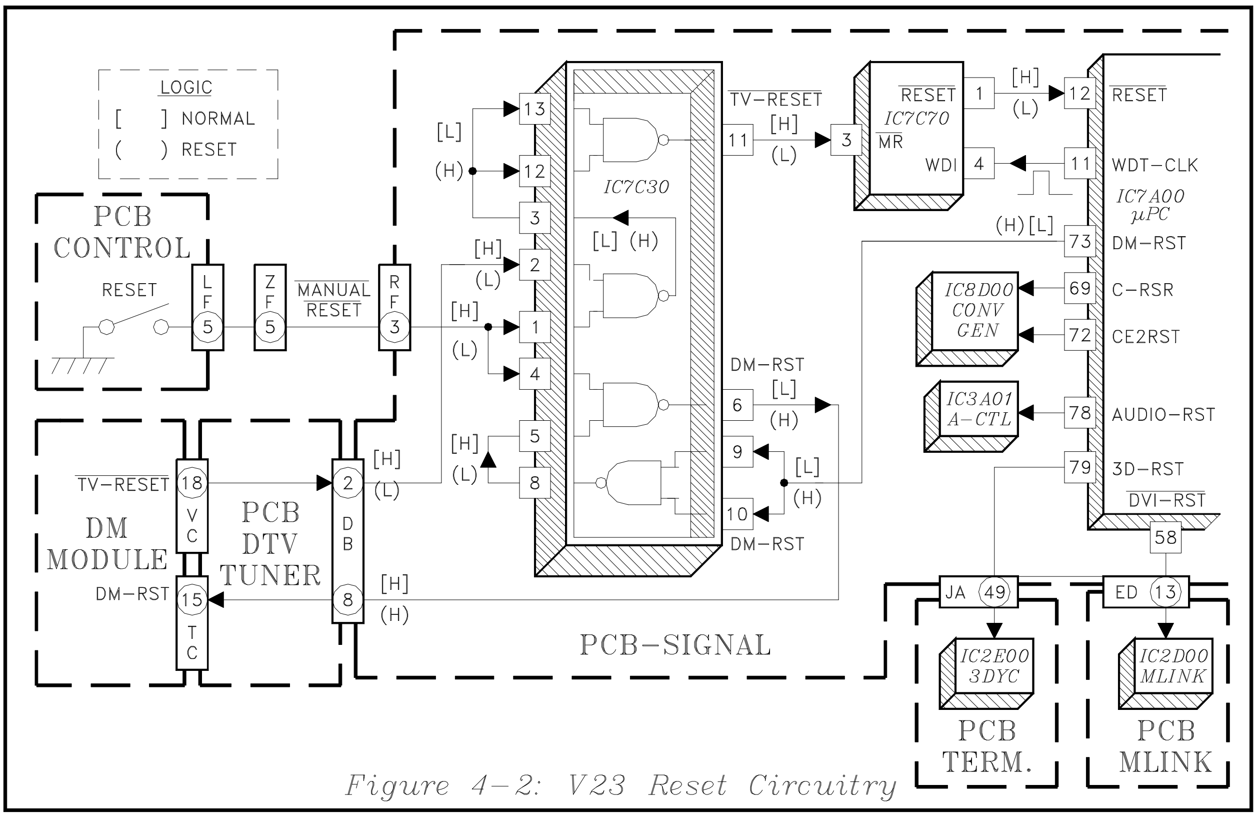


Figure 4−2: V23 Reset Circuitry

Both the µPCs have the ability to reset each other if communication is lost. IC7C30 serves as a Reset interface between the two µPCs and the front panel Reset button. If the TV µPC gets no response from the DM, it outputs a High at pin 73 of IC7A00. The High is routed through IC7C30 and drives the DM-RESET input at pin 15 of the TC connector High.

Conversely, if the DM µPC gets no response from IC7A00, the DM outputs a Low at pin 18 of the VC connector. The Low, through IC7C30 activates a TV Reset pulse from IC7C70.

When the front panel recessed Reset button is pressed, both µPCs are reset through IC7C30.

IC7A00 also outputs reset pulses for the Convergence Generator, Audio Control, 3DYC and MLink circuitry.

Input Command Circuitry

Figure 4-3 illustrates the Command Input circuit. It is basically the same as that in the V19 and V21 so an in depth description is only necessary on those parts that are different.

The front panel Buttons are in a conventional resistive ladder configuration. Pressing a button changes the voltage at the KSC0 or KSC1 input of the µPC. The command is identified by the change in voltage at the KSC input.

There are differences in the Remote input circuitry due to the Remote Learning feature of the V23. As in previous models there are two Remote Preamps:

1) A conventional Mitsubishi Preamp.
2) A wideband Preamp amplifying the IR signals of most manufacturers.

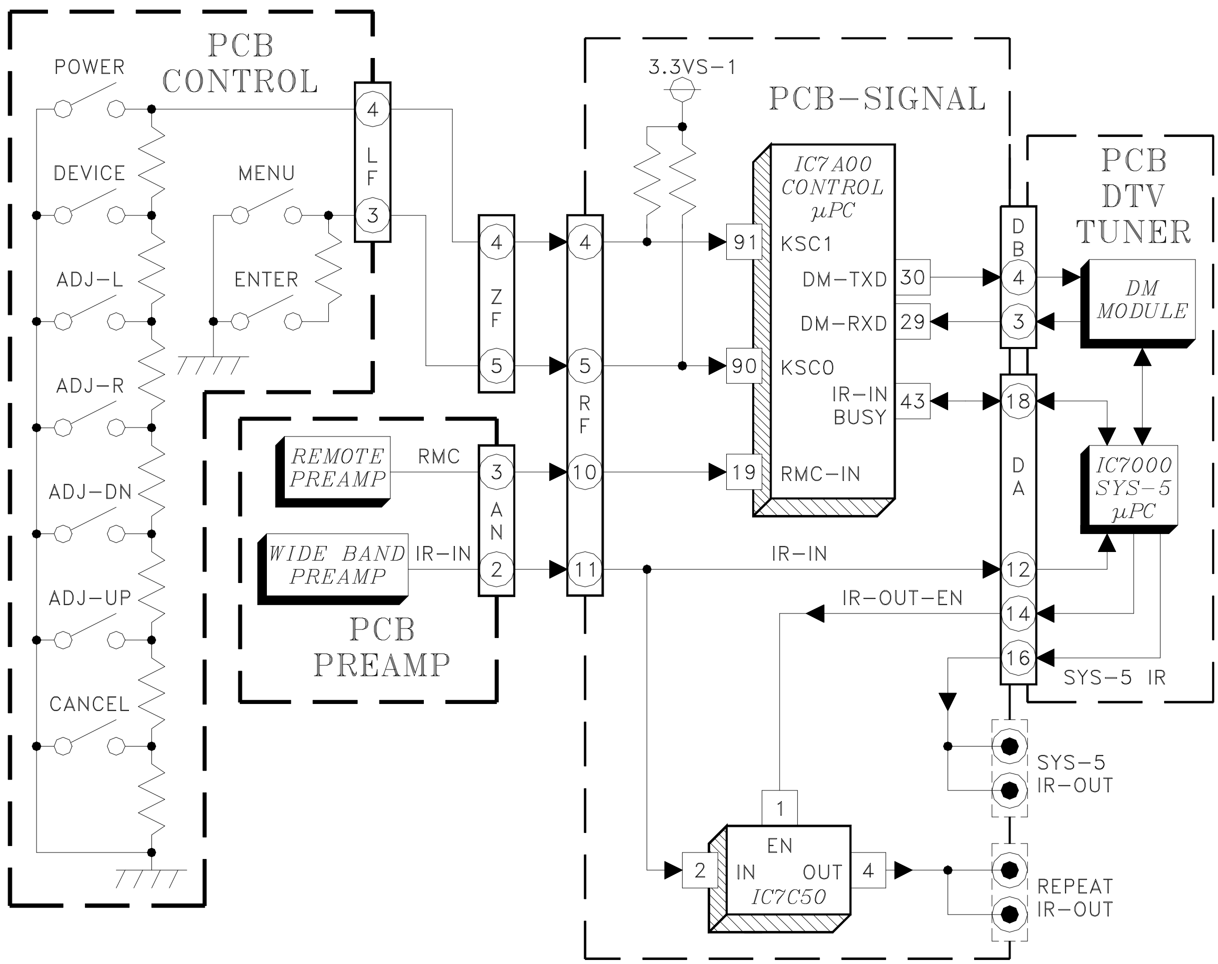


Figure 4–3: Command Input Circuitry

IR signals from a Mitsubishi Remote are directed to the RMC input of IC7A00. The signals are filtered, processed and directed over the IR-IN-BUSY line to the SYS-5 µPC on PCB-DTV TUNER. If the SYS-5 circuitry is busy, it holds the IR-IN-BUSY line Low until it is clear to receive data.

If it is a Mitsubishi command the SYS-5 µPC directs it to the DM Module. The signal is processed and routed back to the TV µPC over the DM-RXD line. If the commands are for a System 5 component they are directed to the SYS-5 IR Blaster Outputs.

Other manufacturers IR signals are amplified by the Wide Band Preamp, directed through IC7C50 to the Repeater IR Blaster Outputs. If IR signals are being output at that time the IR-OUT-EN line disables IC7C50 until the current IR output has ended.

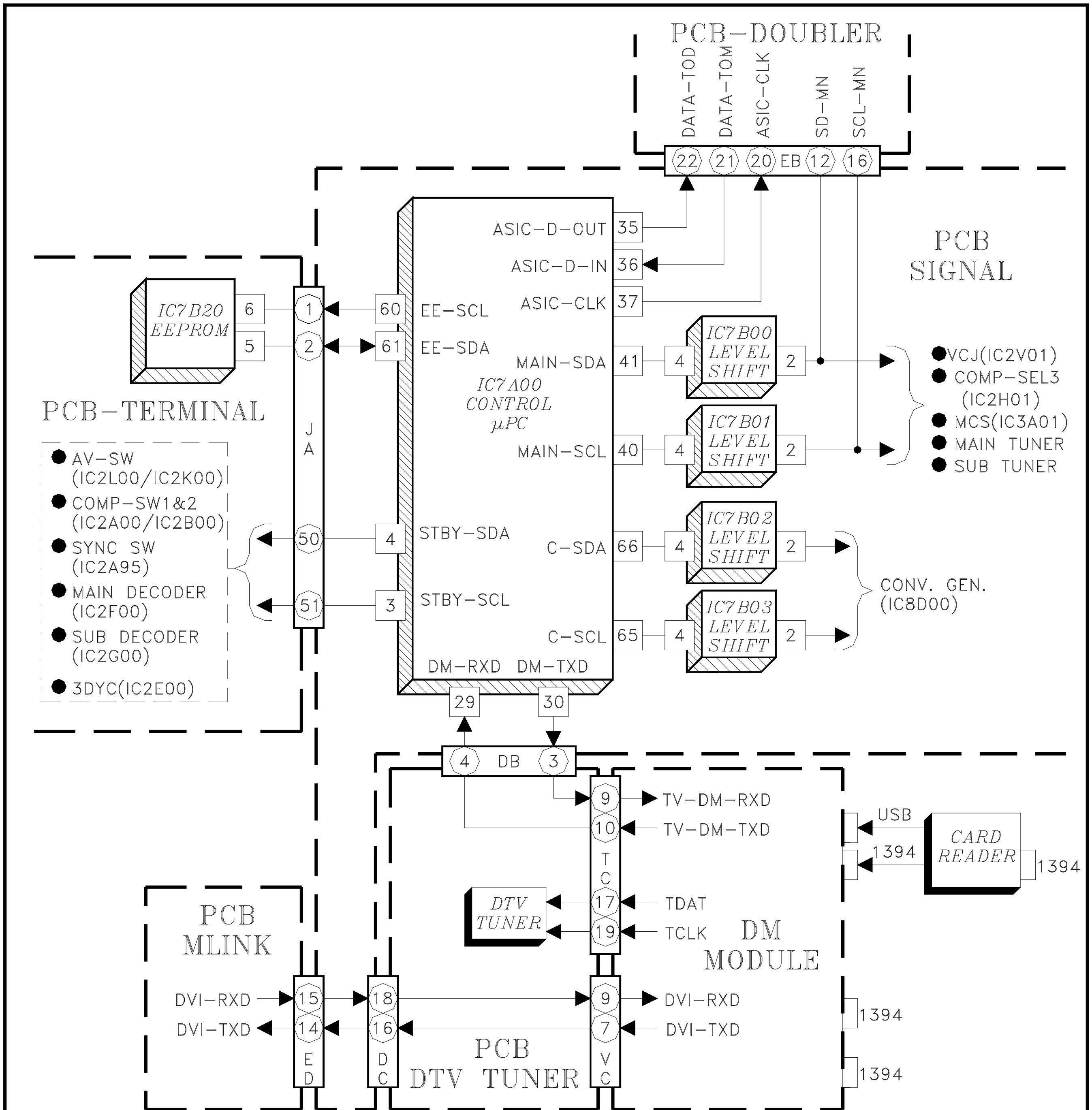


Figure 4-4: Serial Data Lines

Note that the output of the Wide Band Preamp (IR-IN) is also directed to the SYS-5 µPC. This connection was not used in the V19 and V21. It enables the Learning feature. The signals from the units Remote are memorized by the SYS-5 circuitry.

Serial Data Lines

Figure 4-4 shows the Serial Data lines and indicates what circuits they control. ICs IC7B00~IC7B03 are level shift ICs, changing the 3.3V data and clock lines from IC7A00 to 5V lines.

In previous sets the TV Control circuitry used two E2PROM Memory ICs, one on the PCB-SIGNAL and one on the PCB-TERMINAL. Due to the changes in design only one E2PROM is required, and for factory alignment purposes it is located on PCB-TERMINAL.

In the V23 the DTV Tuner and Modulator are separate from the DM Module. The DTV Tuner is controlled by the TDAT and TCLK lines from the DM Module. The DM Module also controls the MLink (DVI) circuitry, through the DVI-RXD and DVI-TXD lines.

Figure 4-4 also shows that the DM Module receives and processes the signals from the Card Reader.

µPC Parallel Inputs

The parallel inputs to the µPC are status inputs or signals inputs required for control purposes.

AC-OFF Input

Informs the µPC if AC Power is lost. The monitoring circuit is shown in *Figure 4-5*. Samples of the input AC are applied to the base of Q9A10. D9A16 removes the negative half of the sine waves. The remaining positive half cycles keep Q9A10 conducting. With Q9A10 conducting PC9A10 conducts, turning Q7A20 On. The conduction of Q7A20 holds the AC-OFF input to IC7A00 Low.

If AC power is lost, Q9A10, PC9A10 and Q7A20 all quit conducting, allowing pin 20 of IC7A00 to go High. This informs the Control circuitry power has been lost. The µPC responds by rapidly storing all user programming and service adjustments to memory. It also outputs a High on the Power Good line, informing the DM of the power loss.

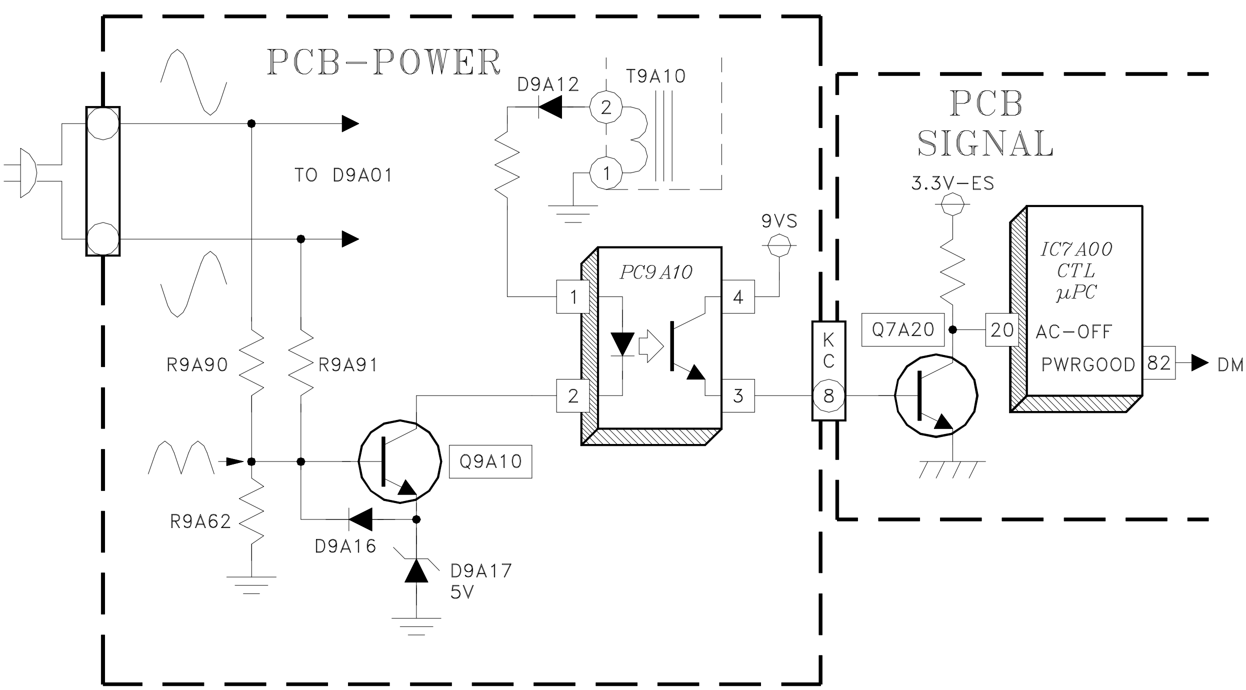


Figure 4-5: AC-OFF Circuitry

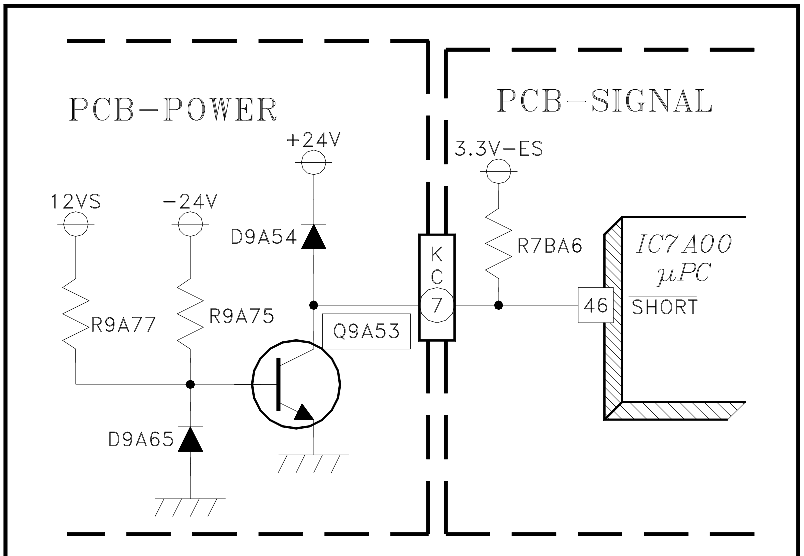


Figure 4−6: Short Detect

SHORT Detect

The short Detect circuitry is shown in *Figure 4-6* and is the same as in the V19 and V21 chassis. If a short occurs in the + or – 24V supplies, pin 46 on IC7A00 goes Low indicating a short and the TV shuts Off. With -24V shorted, the 12VS supply turns Q9A53 On, pulling the SHORT line Low. If +24V is shorted D9A54 is forward biased and the short line goes Low.

X-RAY Protect

Refer to *Figure 4-7*, the X-Ray input is at pin 47 of IC7A00, and is normally High. The X-Ray Protect circuit monitors:

- Excessive HV
- Excess CRT Beam Current
- Excess HV circuit Current

If any of the preceeding occurs, the X-Ray line goes Low, and the TV shuts Off.

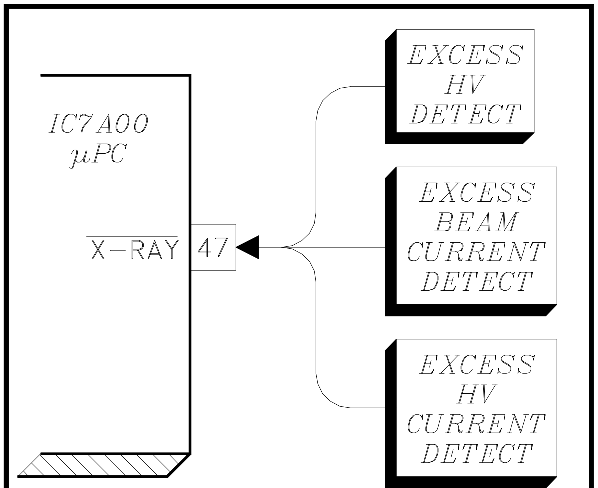


Figure 4−7: X−Ray Input

The monitoring circuits for X-ray Protect are described in the detail in the Deflection and HV Section. Other parallel inputs to the µPC, are listed in *Table 4-1*.

IC7A00 Additional Inputs

Pin #	Name	Source
6	SD-SUB	Sub Tuner Sync Detector
7	SD-MAIN	Main Tuner Sync Detector
62	H-SYNC-IN	ASIC Horizontal Sync
64	V-SYNC-IN	ASIC Vertical Sync
92	AFT1	Main Tuner AFT voltage.
93	AFT2	Sub Tuner AFT voltage
94	VBLK	Deflection Loss Detect circuit
97	CV-IN-SUB	Sub Video (CCD, V-chip,etc)
100	CV-IN-MAIN	Main Video (CCD, V-chip,etc)

Table 4-1: µPC Inputs

Additional IC7A00 Outputs

Pin #	Name	Purpose
42	BLNK-CRT	Blanks CRTs during Input &Channel changes.
49	PON-2	Power ON: (Defl, Conv, HV, etc. circuitry)
50	PON-1	Power ON: Signal Processing circuitry)
51	BWC	Band Width Control for Doubler Output
52	F	Sets the Free Run Horizontal Frequency
56	F31K	Decreases H-Defl DC supply for 31.5 kHz.
57	DEFL-MUTE	Decreases H-Defl DC supply during freq. change.
71	BLK-EN	Enables OSD Insertion
76	MUTE SUB	Mutes Sub Picture Audio Output
80	MUTE SPKR	Mutes the TV's Speakers
82	POWERGOOD	Informs the DM that the DC Power is ok
86	MUTE MON	Mutes Monitor Out Audio
87	SUB POWER	Activates/Deactivates the Economy Mode

Table 4-2: µPC Outputs

Parallel Outputs

Most of the parallel outputs are listed in *Table 4-2.* Most of them have been used before and need no explanation. However, the function of two items should be described.

BWC (Band Width Control)
This line is directed to the Doubler circuitry, and automatically becomes active when the signal source is NTSC. The Doubler circuit is designed to produce the best possible picture for an HDTV signal. Due to this design, artifacts may appear in the picture when the signal source is NTSC.

With an NTSC source, the BWC line automatically goes High. The High reduces some of the high frequency output from the Doubler, removing the unwanted artifacts.

BLK-EN
Figure 4-8 illustrates the BLK-EN circuitry. The BLK-EN selects the path for the OSD insertion timing signal (DM-BLK). The OSD signals and the DM-BLK timing signal are generated in the DM Module.

If the source signal is not from the DTV Tuner or a 1394 input, the OSD signal is inserted in the main signal in the VCJ IC2V01. The Timing Signal (DM-BLK) is applied to the inputs of IC2V02 and ICSVO3. IC2V02 directs the signal to the VCJ, and IC2V03 directs the signal to the Doubler circuit. The path of the DM-BLK signal is determined by BLK-EN from the TV µPC.

BLK-EN is applied directly to the OE (Output Enable) input of IC2V03, and is inverted by Q2X04 and applied to the OE input of IC2V02. IC2V02 and IC2V03 are enabled when their OE input GOES Low.

When EN-BLK is High, IC2V02 is enabled and the DM-BLK is directed to the VCJ. When EN-BLK is Low, DM-BLK is directed to the Doubler. DM-BLK is needed in Doubler, even though the OSD insertion for a DM signal occurs in the DM Module.

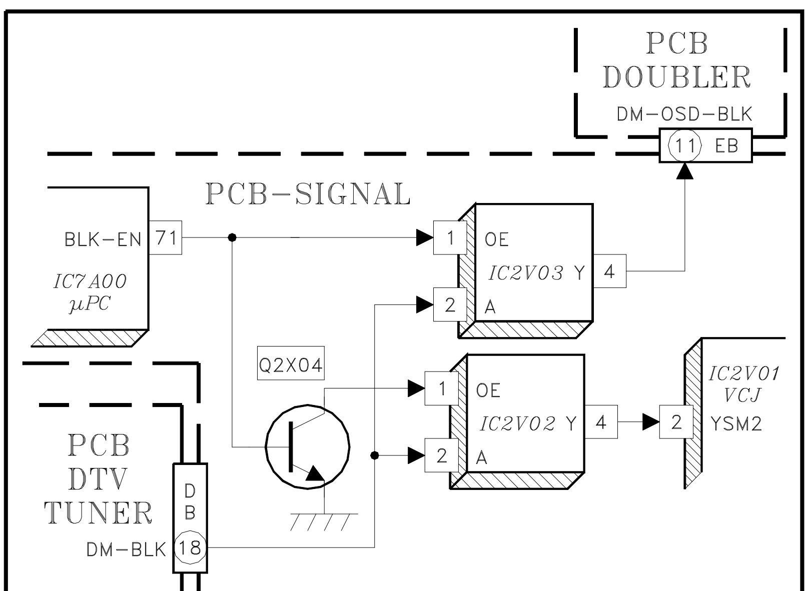


Figure 4-8: BLK-EN circuit

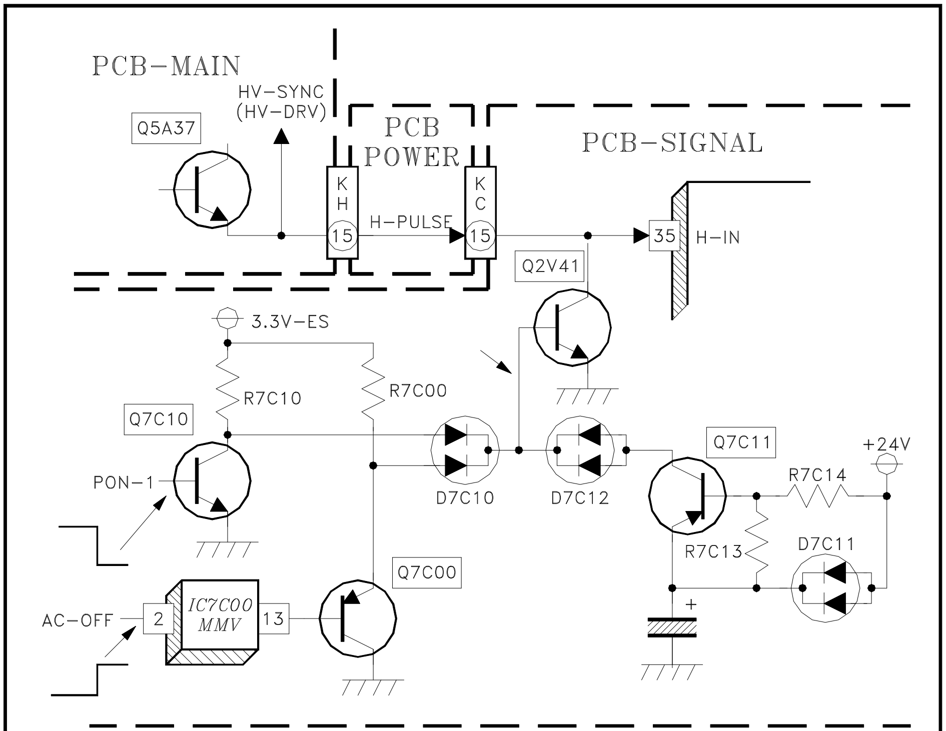


Figure 4-9: Flash Circuit

The PerfectColor feature is performed in the Doubler circuit, therefore all signal sources must pass through the Doubler. With DM signal sources, any OSD is already inserted in the signal before it goes to the Doubler. The PerfectColor circuitry can cause incorrect color in the OSD. The DM-BLK signal is directed to the Doubler when the source is Digital, momentarily disabling the PerfectColor during the OSD.

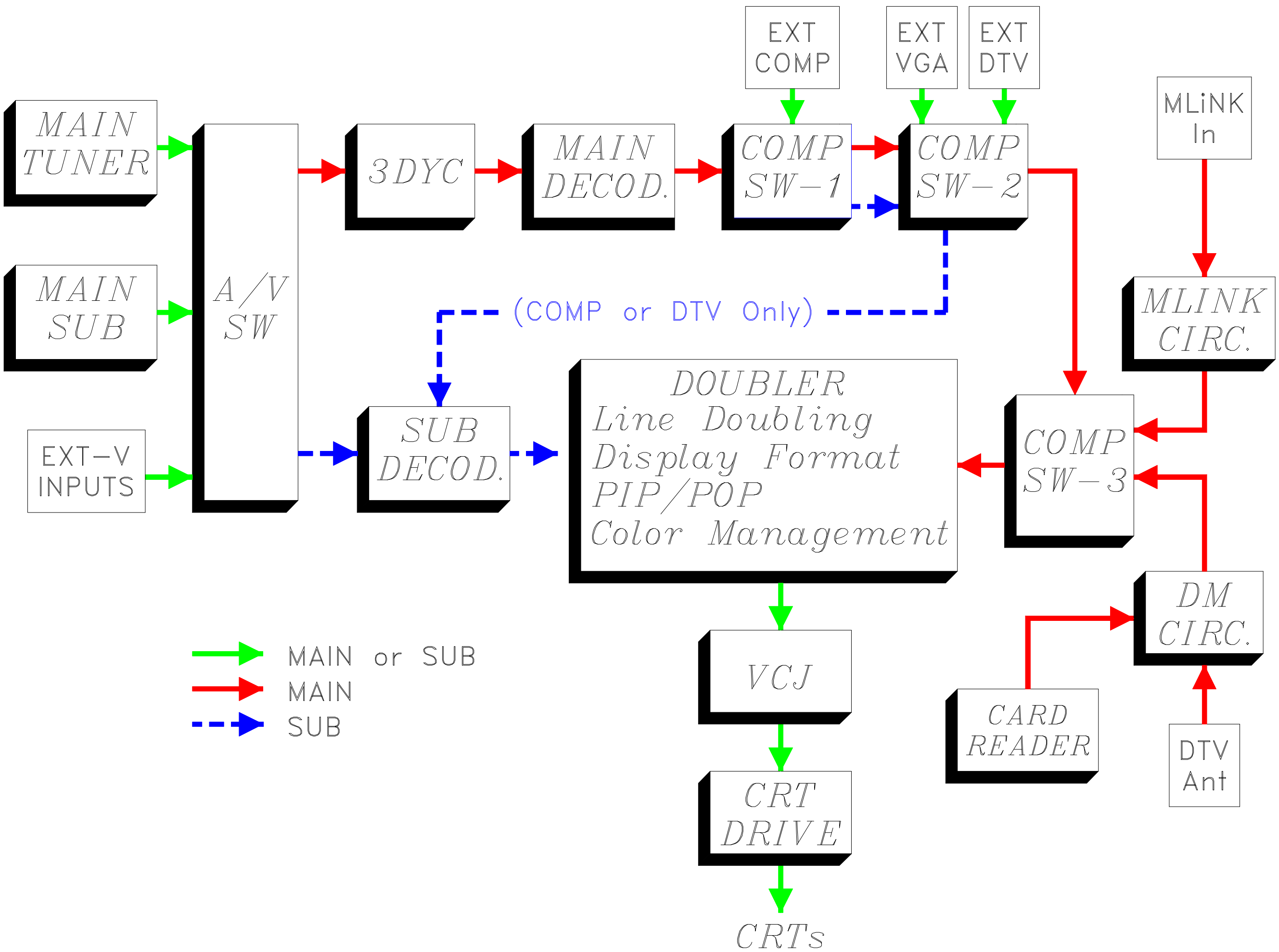
Flash Circuit

Figure 4-9 shows the Flash Circuit in the V23. This circuit is not controlled by the µPCs, but can be considered a status sensor. It prevents a momentary flash on the screen:

- When the TV is switched Off (PON-1 goes Low)
- If AC power is lost. (AC-OFF goes High)
- If the +24V supply is lost (Q7C11 conducts)

If any of the above occurs, drive to the HV circuit is removed to prevent any flash on the screen. The Flash line goes High, turns On Q2V41, which removes HV Drive.

Chapter 5
Video/Color Circuitry



The above block diagram illustrates the Video/Color circuitry in the V23 chassis. Although initially it looks the same as in the V21, there are differences. The A/V Switch circuitry still selects main and sub picture signals from NTSC signal sources. Although it's not apparent from the Block Diagram, the NTSC Decoders, Component Switch ICs, and the Doubler circuitry are different.

Note that all main picture sources, including the DTV Tuner, are processed by the Doubler circuitry. In the V21, 480p and DM signals only were processed by the Doubler circuitry when a display other than Standard format was selected, or when PIP/POP was activated. The new improved Color Management (ColorPerfect™) circuitry is in the Doubler circuitry and it now processes all signal sources. Therefore all signals must pass through the Doubler. Two additional signal sources are shown in the Block Diagram, MLink (DVI) Input, and a Memory Card Reader located in the front of the TV.

Also the diagram indicates that the Sub Picture source can only be from a NTSC source, an External Component Input or the DTV input.

PCB-TERMINAL Video Path

Figure 5-1 illustrates the Video Signal Path on the PCB-TERMINAL. The AV-Switch circuitry has not changed, IC2L00 and IC2K00 are the same ICs used in the V21 chassis.

The 3DYC Motion Adaptive Come Filter provides a clean separation of luminance (Y) and chroma (C) signals.

The Main and Sub Decoders are new, generic #TA12440AF. Their functions include:

- Converting NTSC to YPbPr.
- Sync Separation
- Detecting signal format (480i, 480p, etc.)
- Converting RGB to YPbPr.

The Component Switch ICs are also new, generic # MM1519XQ. There are two Component Switch ICs on PCB-TERMINAL, and a third one on PCB-SIGNAL, not shown in *Figure 5-1*.

IC2A00 selects the Main and Sub picture sources from:

- Main Decoder output
- External Comp-1 Input
- External Comp-2 input

IC2B00 selects the Main and Sub picture sources from:

- The outputs of IC2A00
- The External DTV Inputs
- The VGA Input

The VGA Input cannot be selected as the Sub picture source.

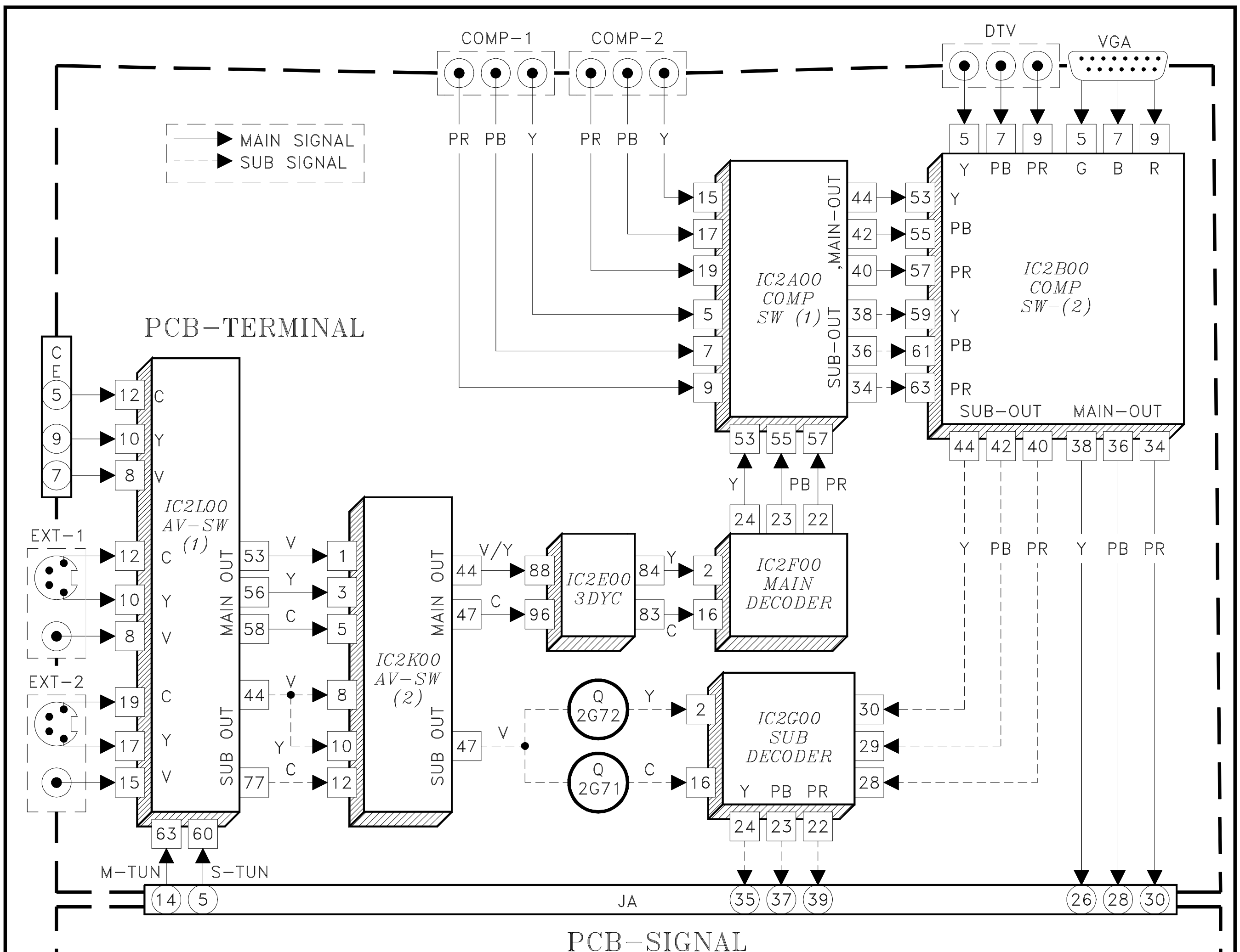


Figure 5-1: PCB-TERMINAL Video Path

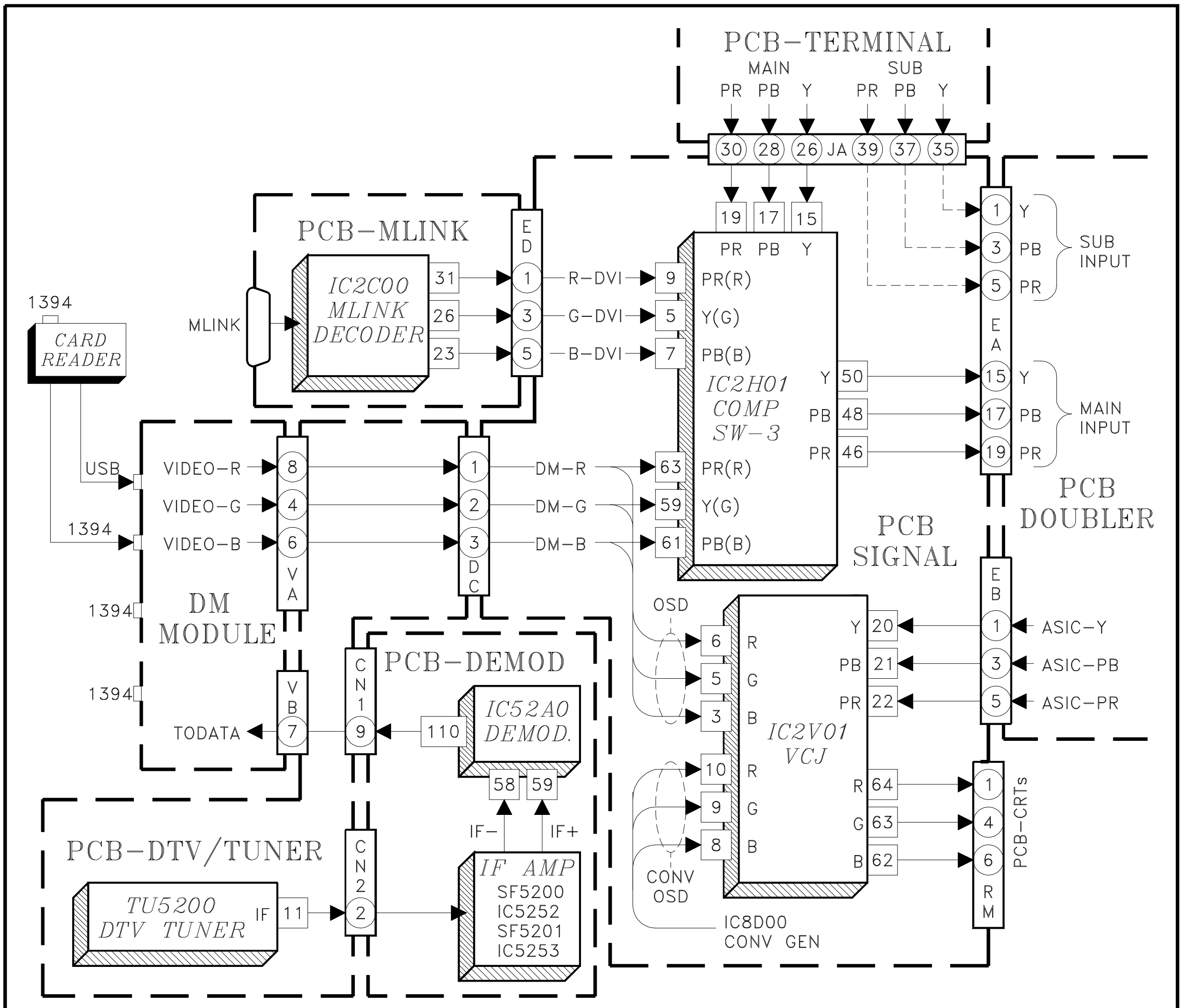


Figure 5-2: PCB-SIGNAL Video Path

The Sub picture signals from IC2B00 are directed to IC2G00, the Sub Decoder. Switch circuitry in IC2G00 selects Sub picture signals from IC2B00 or the AV-SW(2), IC2K00.

As in previous chassis, the main and sub selected YPbPr signal are direct to the PCB-SIGNAL.

PCB-SIGNAL Video Path

Figure 5-2 shows the PCB-SIGNAL Video Signal Path. Sub picture signals from PCB-TERMINAL are routed directly to the Sub YPbPr inputs of PCB-DOUBLER.

The main picture signals from PCB-TERMINAL are routed to COMP SW-3, IC2H01. IC2H01 selects the main signal from the PCB-TERMINAL main outputs, or the MLINK signal from the MLINK Decoder, or the RGB signal from the DM Module. The output of IC2H01 is applied to the Main Picture inputs to the Doubler circuit.

Note that the OSD RGB signals from the DM Module are also directed the VCJ, IC2V01.

On-Screen Display (OSD) signals are generated in the DM Module, and when the signal source is not the DM, OSD is inserted in the main picture in the VCJ. If the source is from the DM, the DTV Tuner or 1394 inputs, OSD insertion occurs in the DM module.

The diagram also shows that Convergence OSD signals are applied to the VCJ and inserted in the VCJ.

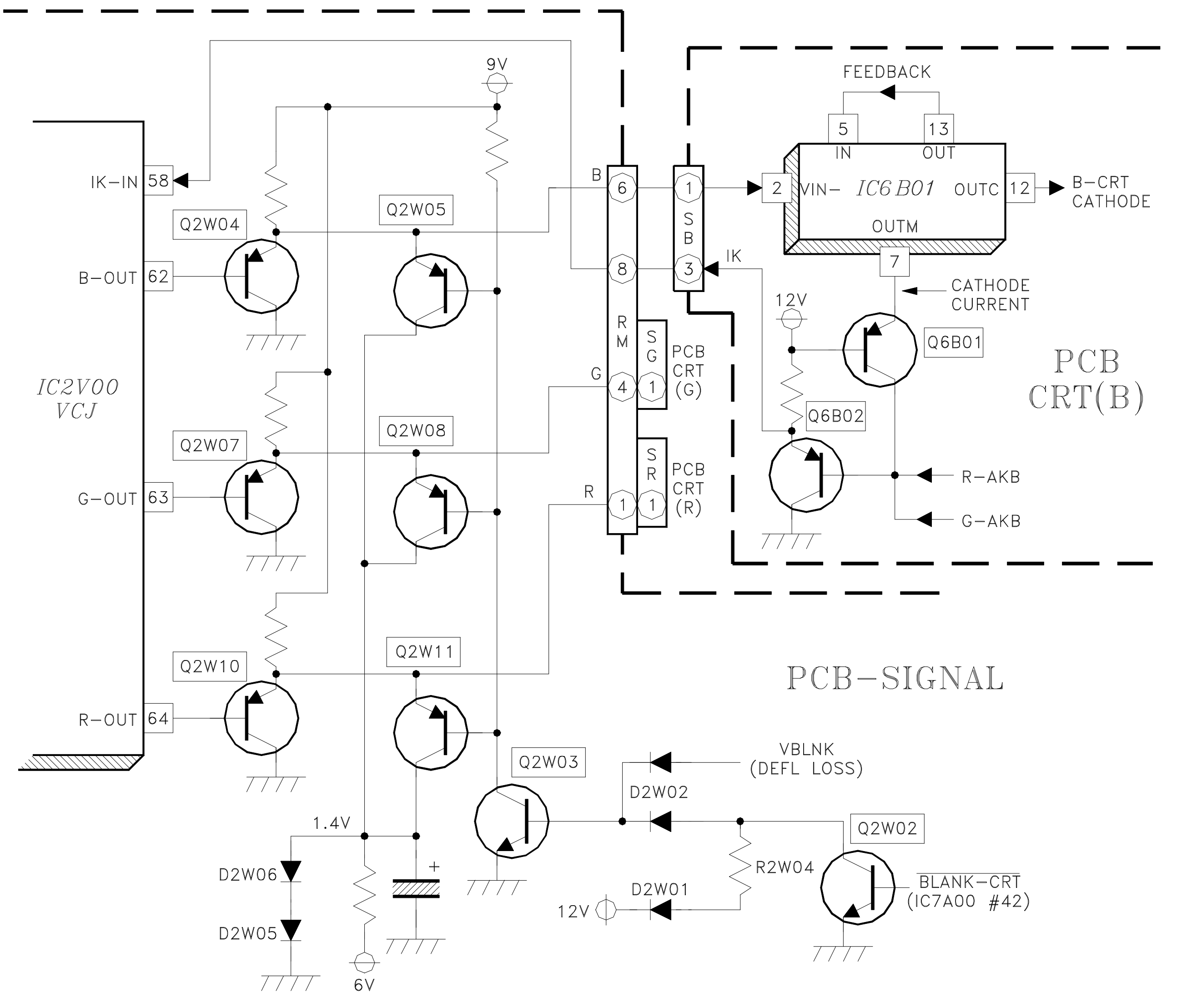


Figure 5-3: CRT Drive & CRT Protect

The outputs of the Doubler circuit, ASIC-Y, ASIC-Pb and ASIC-Pr are directed to the VCJ. The signals are processed in the VCJ and CRT RGB drive signals are output at pins 64, 63, and 62.

CRT Drive & Protect Circuitry

Figure 5-3 shows the CRT Drive circuitry. Since it is the same as that in the V21, no explanation is necessary. The CRT Protection circuitry is also the same as the V21, but a review may be in order.

When Q2W03 conducts, it turn On Q2W05, Q2W08 and Q2W11. The conduction of the three transistors removes RGB drive to the CRTS.

The conduction of Q2W03 is controlled from two sources:

1) The BLANK-CRT command from the µPC, momentarily blanking the CRTs during channel or input selection changes.
2) The VBLNK line. The logic on the VBLNK line is controlled by Deflection Loss Detection circuitry.

A High on VBLNK blanks the CRTs. The Deflection Loss Detection circuitry is discussed in detail in the Section on Deflection and HV.

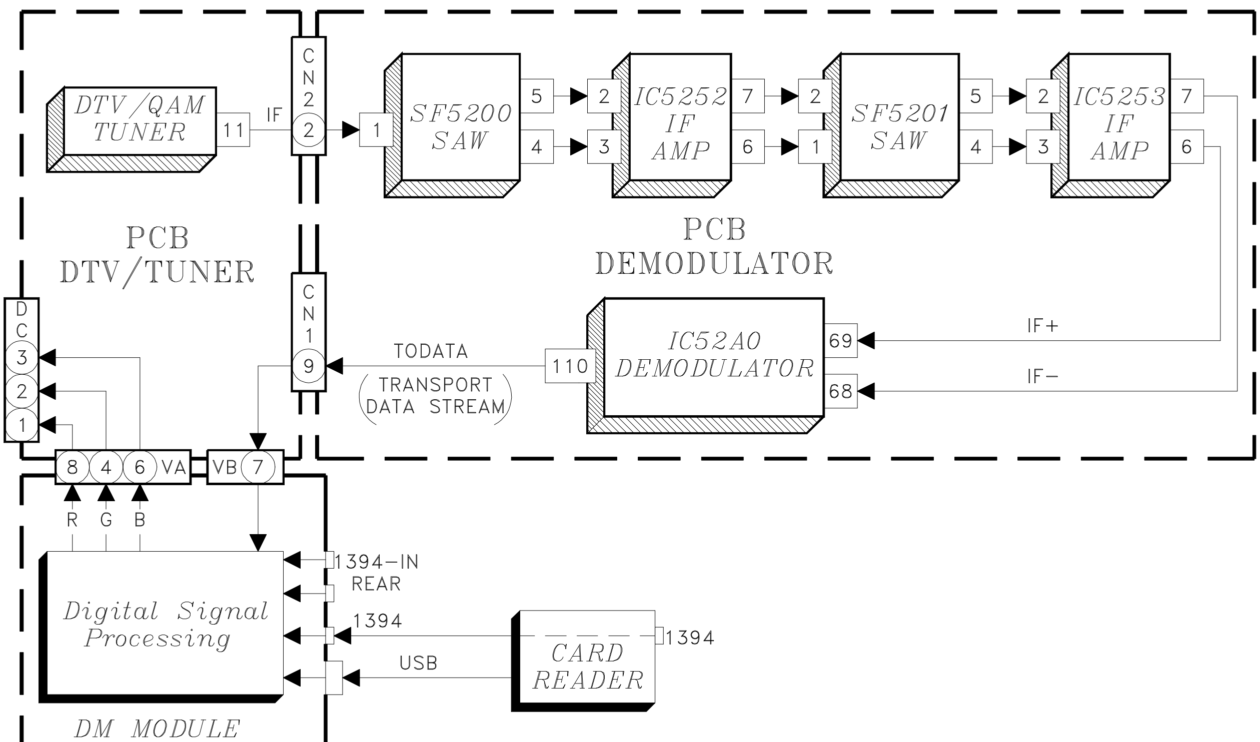


Figure 5−4: Digital Signal Path

Digital Signal Path

The basic Digital Signal path was shown in *Figure 5-2*. *Figure 5-4* shows the Digital Path in more detail. Digital signal sources are the DTV/AQM Tuner, 1394 Inputs and the front panel Card Reader. There are two 1394 inputs at the rear of the DM module. A third 1394 input is on the front of the Card Reader. The Card Reader serves as a feed through for the 1394 signals and does not process these signals at all.

The I.F. signal from the DTV/QAM Tuner is directed to PCB-DEMODULATOR. The I.F. signal passes through two SAW filters, and two I.F. amp ICs, SF5200, IC5252, SF5201 and IC5253, in that order.

The (+) and (-) I.F. signals from IC5253 are directed to pin 69 and 68 of the Demodulator, IC52A0. The output of the Demodulator is the Transport data stream used to modulate the carrier at the station.

The Transport Data Stream (TODATA) is directed to the Digital Module. The signal is processed by the circuitry in the DM, and results in analog RGB signals output at pins 8, 4, and 6 of the VA connector.

Signals from the 1394 inputs are processed in the DM Digital Signal Processing circuitry and are output as analog RGB signals at VA connector.

Signals from the Card Reader are send to the DM over a USB cable. The DM also processes these signals and outputs the resulting analog RGB signals.

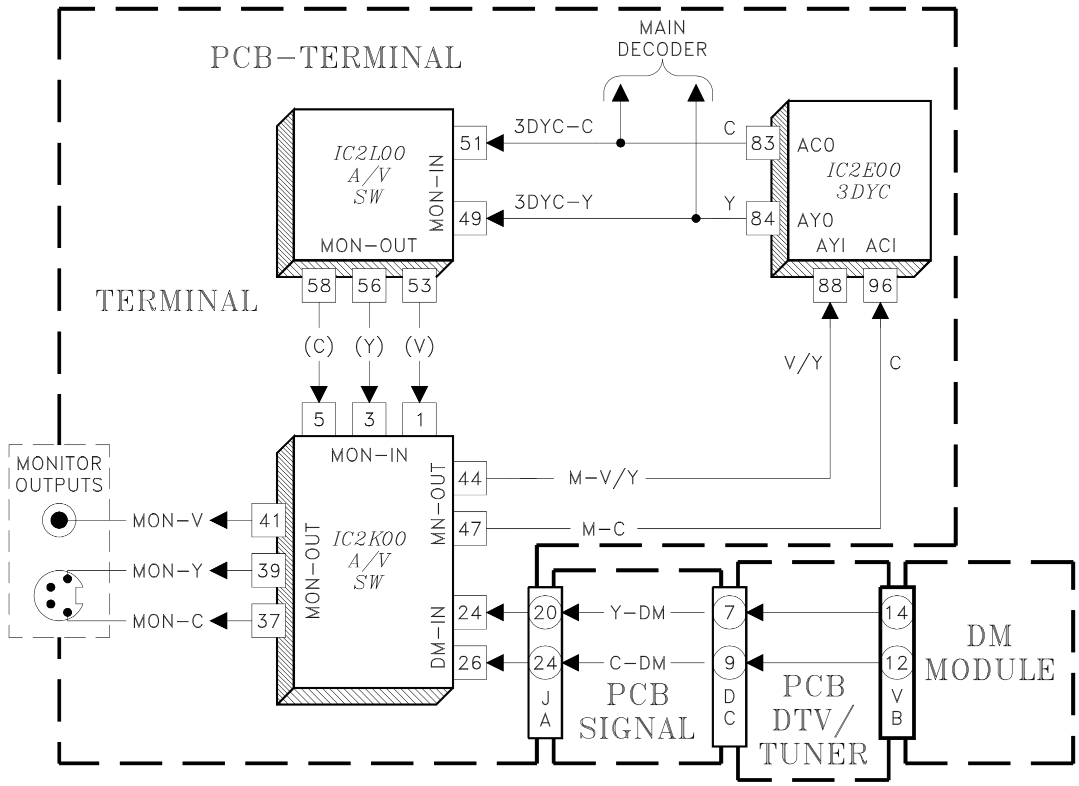


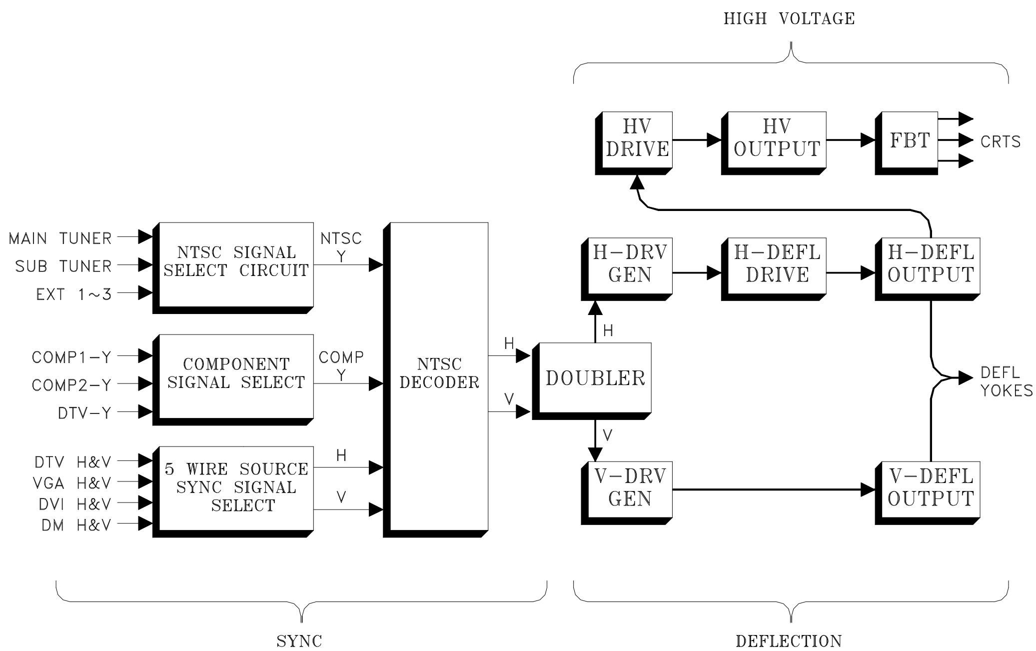
Figure 5-5: Monitor Out Signal Path

Monitor Out Circuit

Figure 5-5 shows that the Monitor Output signal source is limited to an NTSC source, or the DM Module. The NTSC Y and C signals from the 3DYC Comb Filter, are directed back to IC2L00. IC2L00 directs the signals to the monitor Inputs of IC2K00. IC2K00 selects the signal from IC2L00 or the DM signal input at pins 24 and 26 of IC2K00.

If the signal source is from a Component Input, the DTV Input, VGA Input or MLINK Input, no signal is available at the Monitor Outputs.

Chapter 6
Sync, Deflection & High Voltage



The Overall Sync, Deflection and Hign Voltage circuitry in the V23 is shown in the Block Diagram at the top of the page. The V23 can display either of two scanning formats, 480p or 1080i. The horizontal scanning frequency for 480p is 31.5 kHz, and 1080i is 33.75 kHz.

Conventional 480i TV signals have a scanning rate of 15.75 kHz. For these signals, line doubling circuitry changes the signal format from 480i to 480p.

In NTSC and Component format signals, horizontal and vertical sync must be extracted from the Y signal by the NTSC Decoder. For the DTV Input, the signal can be either Y,Pr,Pb or RGB/HV, sometimes referred to as “5-wire.” (Sync on green is no longer an option.) Obviously all 5-wire inputs have separate horizontal and vertical sync.

Sync Select circuitry selects the Main picture sync source. The selected output is used to synchronize the Horizontal and Vertical Deflection Generators. If the source signal is 480i, horizontal sync is doubled, before synchronizing the Horizontal Drive Generator.

Horizontal deflection drive is amplified by the Horizontal Output circuitry and directed to the horizontal windings in the Deflection Yokes. The signal from the Horizontal Output is also directed to HV Drive circuitry. HV Drive is amplified at directed to the Flyback transformer.

Vertical sync synchronizes the Vertical Deflection Generator. Output from the Vertical Generator is amplified in the Vertical Output circuitry and directed to the vertical windings in the Deflection Yokes.

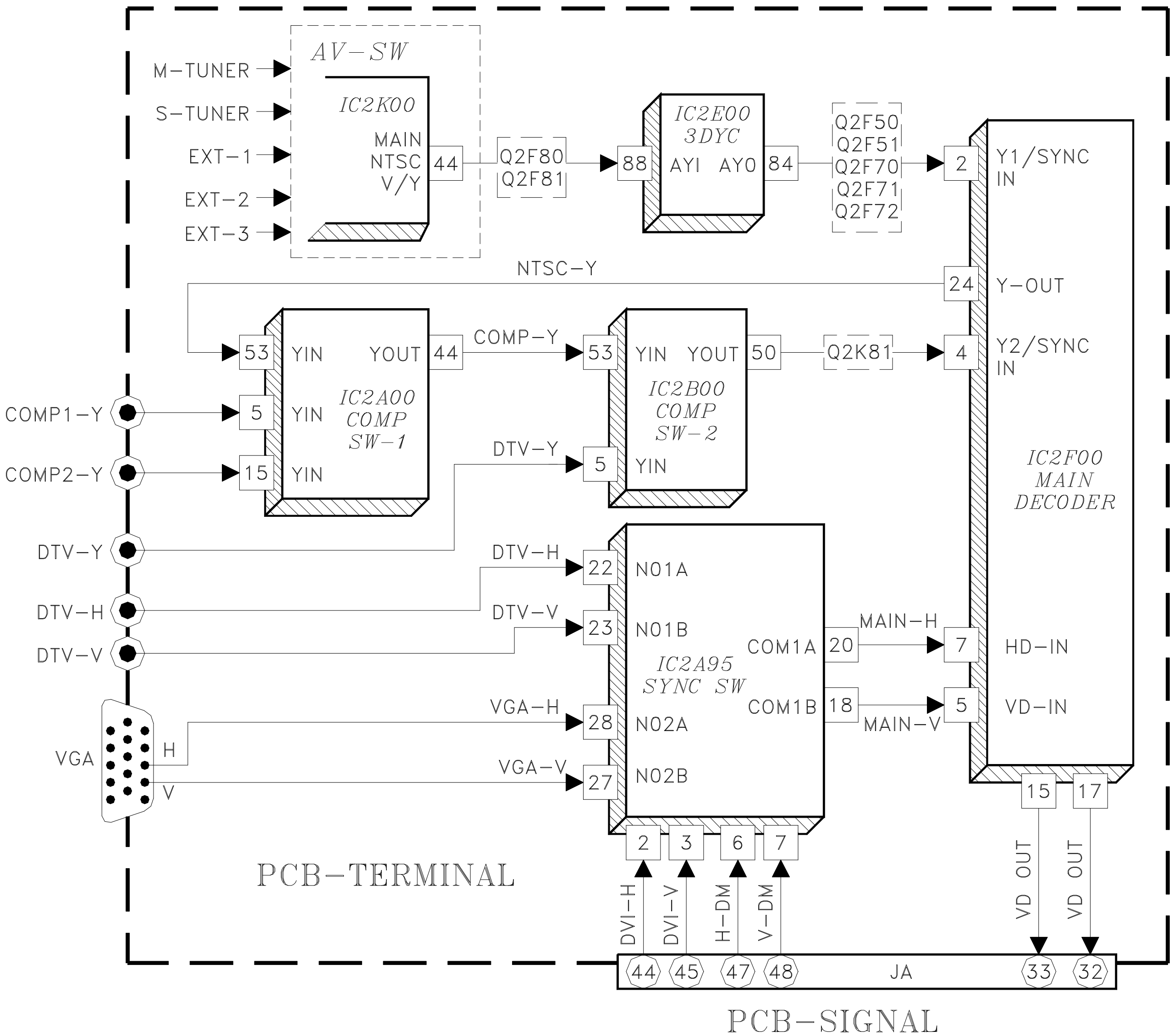


Figure 6-1: Main Sync PCB-TERMINAL Signal Path

Sync Signal Path

Figure 6-1 illustrates the Sync Signal Path for the Main Picture signals on the PCB-Terminal. IC2K00, IC2A00, IC2B00 and IC2A95 comprise the Main Picture Sync Select Circuitry. Sync must be extracted from NTSC, Composite and Component Format Y Signals. NTSC and Composite signals are 480i scanning format. Component signals can be 480i, 480p or 1080i.

IC2F00, the Main NTSC Decoder, extracts horizontal and vertical sync when the source signal is composite or component video.

IC2A95 selects the already seperate vertical and horizontal sync from the 5-wire sources.

- DTV (when the source is 5-wire)
- VGA
- DVI (decoded from the digital signal)
- DM (also decoded from a digital signal)

The selected sync is directed to the PCB-Signal via connector JA, pins 32 and 33, and then to the Doubler circuitry.

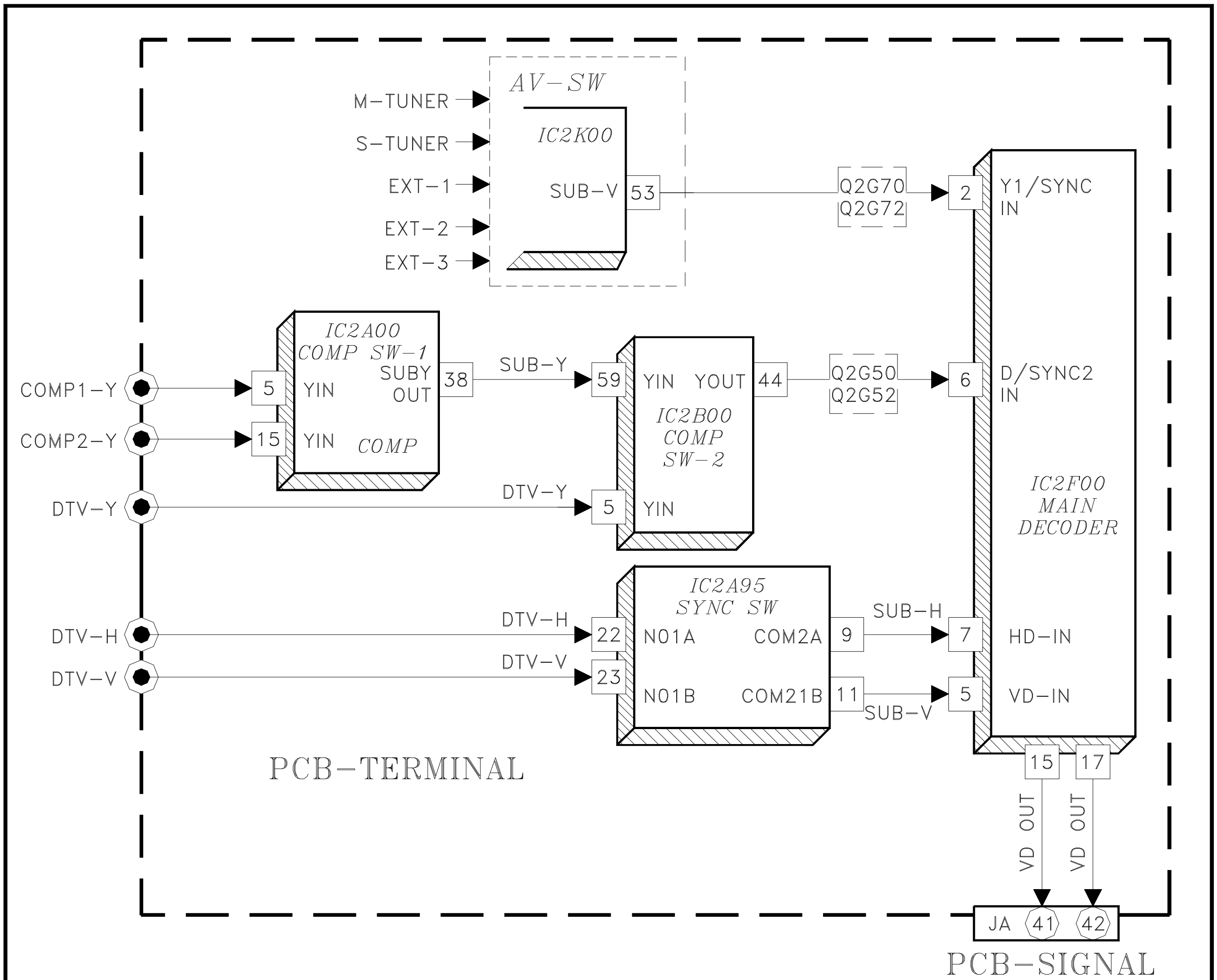


Figure 6-2: Sub Sync PCB-TERMINAL Signal Path

Figure 6-2 illustrates the Sub Sync Signal Path for the Sub-Picture signals on the PCB-Terminal. It functions the same as the Main Sync Signal Path using different pin sets on the same ICs. The sub sync signals are used by Doubler circuitry for POP/PIP signal processing.

Figure 6-3 shows the sync signal functions performed by the PCN-Signal. It serves to interface the sync signals as follows:

- DVI and DM inputs to the PCB-Terminal
- Selected Main and Sub sync signals from the Terminal to the Doubler PCBs.
- Sync from the doubler to the VCJ

The selected sync is directed to the Doubler circuitry. If the selected source is 480i, the number of horizontal lines are doubled. When the selected source is 480p or 1080i, no line doubling is required. However, since all sync signals, 480i, 480p and 1080i pass through the PCB-DOUBLER, the TV cannot be operated with the PCB-DOUBLER unplugged.

IC2X10 and IC2X11 are flip-flops serving as schmitt triggers. They effectively remove any spikes or noise that may be riding on the sync, preventing false triggering.

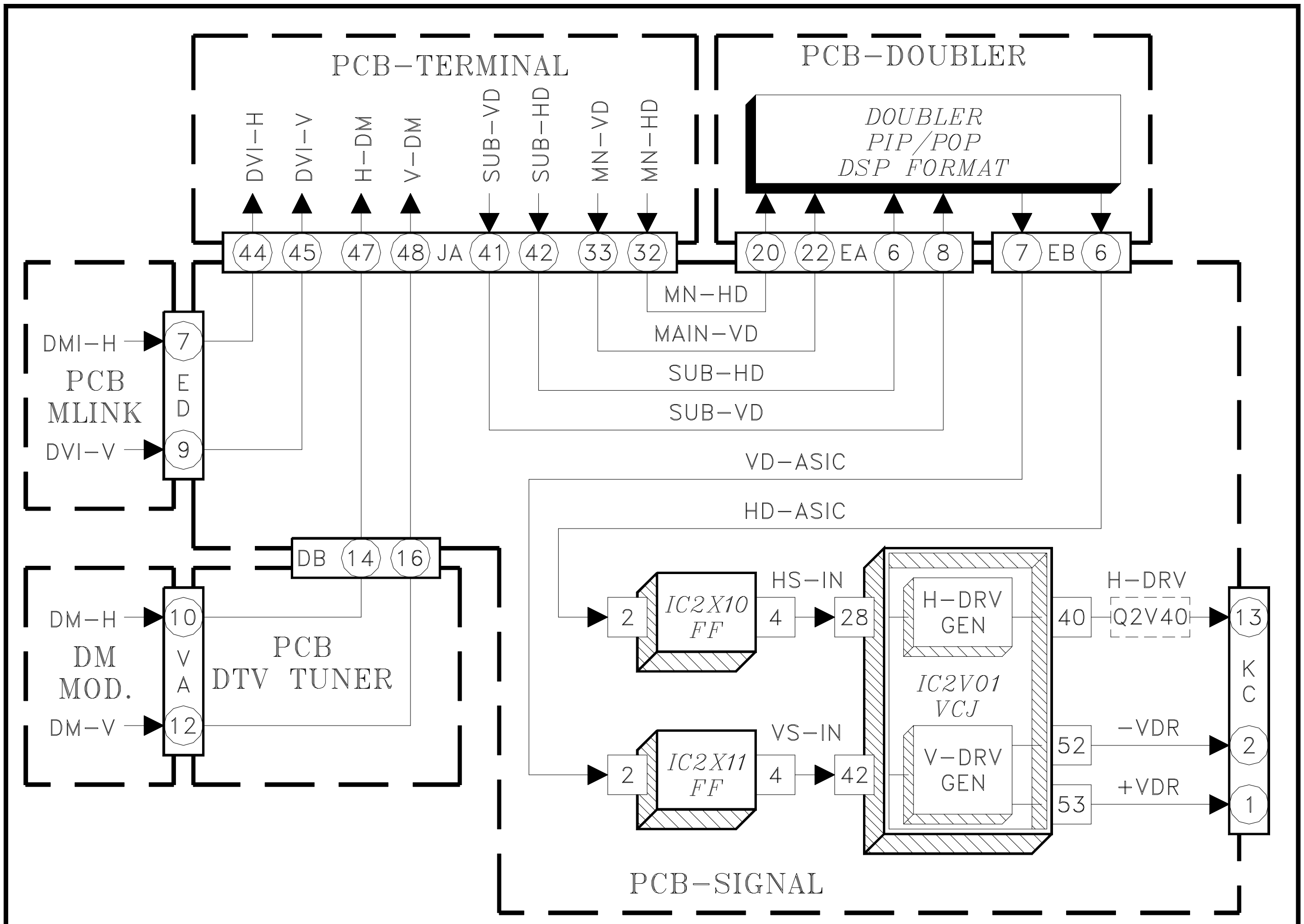


Figure 6-3: PCB-SIGNAL Sync Signal Path

From the flip-flops, sync pulses are directed to the VCJ, IC2V01. Both Horizontal and Vertical Drive Generators are in the VCJ. Horizontal drive is output at pin 40, and vertical drive is output at pins 52 and 53. The signals are directed to their respective output circuitry on the PCB-MAIN.

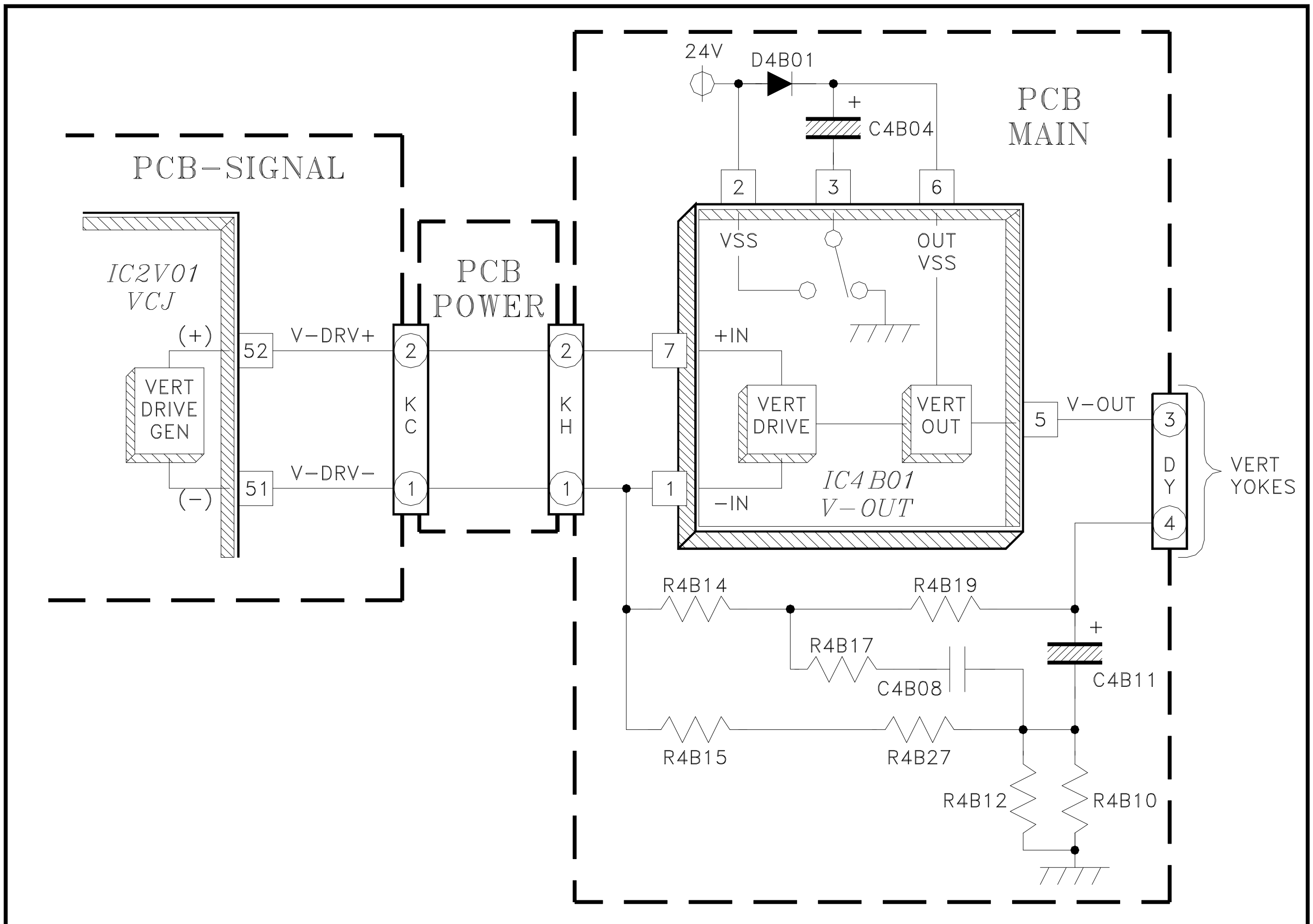


Figure 6-4: Vertical Deflection Circuitry

Vertical Deflection

Figure 6-4 shows the Vertical Deflection circuitry. The Vertical Deflection Generator in the VCJ outputs push-pull type of vertical deflection drive signal. +VDR at pin 53 and –VDR atz pin 52. Both signals are applied to the Vertical Output IC, IC4B01. The amplified output from IC4B01 is directed to the vertical coils in the Deflection Yokes.

D4B01 and C4B04 make up the pump-up circuitry.

Feedback from the Deflection Yokes ground return at pin 4 of DY, to pin 1 of IC4B01, provide linearity and S correction.

Horizontal Deflection

Figure 6-4 illustrates the Horizontal Deflection Drive and Output circuitry. Horizontal drive signal from the VCJ is amplified by Horizontal Drive circuitry including transistors Q2V40, Q5A40, Q5A33, Q5A39 and Q5A32.

The output from Q5A32 is directed to Q5A31, the Horizontal Output transistor. The output from Q5A31 takes three paths:

1) To the horizontal windings in the Deflection Yokes
2) Through C5A34 and Q5A37 to the HV Drive circuitry.
3) Through T5A31, providing the source for the CRT filament supply.

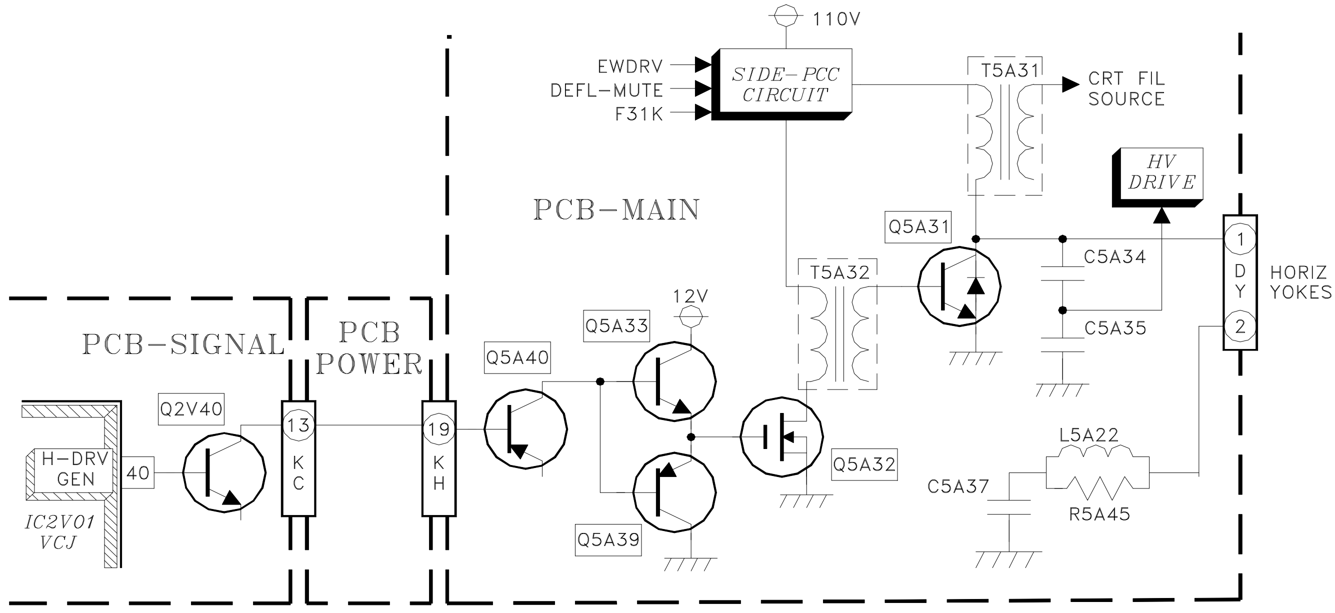


Figure 6-5: Horizontal Deflection

Horizontal Deflection DC Supply Circuitry

The DC supplies for Q5A32 and Q5A31 are derived from Horizontal Deflection DC Supply circuitry. The 31K line from the Control μPC controls the DC voltage for Q5A31. Q5A31 supply voltage is approximately 10 volts higher for the 33.75 kHz scan format (1080i), than that for the 31.5 kHz scan (480p),

The H-Deflection DC Supply circuitry is also used to:

- Add side pincushion correction, controlled by the EWDRV signal from the VCJ.
- Reduce the Deflection DC supply during scanning frequency changes.

Figure 6-6 shows the Horizontal Deflection DC Supply circuitry. The conduction of Q5A01 determines the value of the DC Supply for the Horizontal Output Transistor, Q5A31.

The conduction of Q5A01 is controlled by Q5A06, Q5A05, Q5A03 and Q5A02. EWDRV signal is applied to the base of Q5A06 for Side Pincushion Correction.

When the base voltage of Q5A06 decreases, Q5A01 conducts less, lowering the Horizontal Output DC supply. When is the 31.5 kHz scan mode, the 31K line from the μPC goes High. The High drives Q5A07 into conduction, reducing the base voltage of Q5A06, which reduces the DC supply to the Horizontal Output.

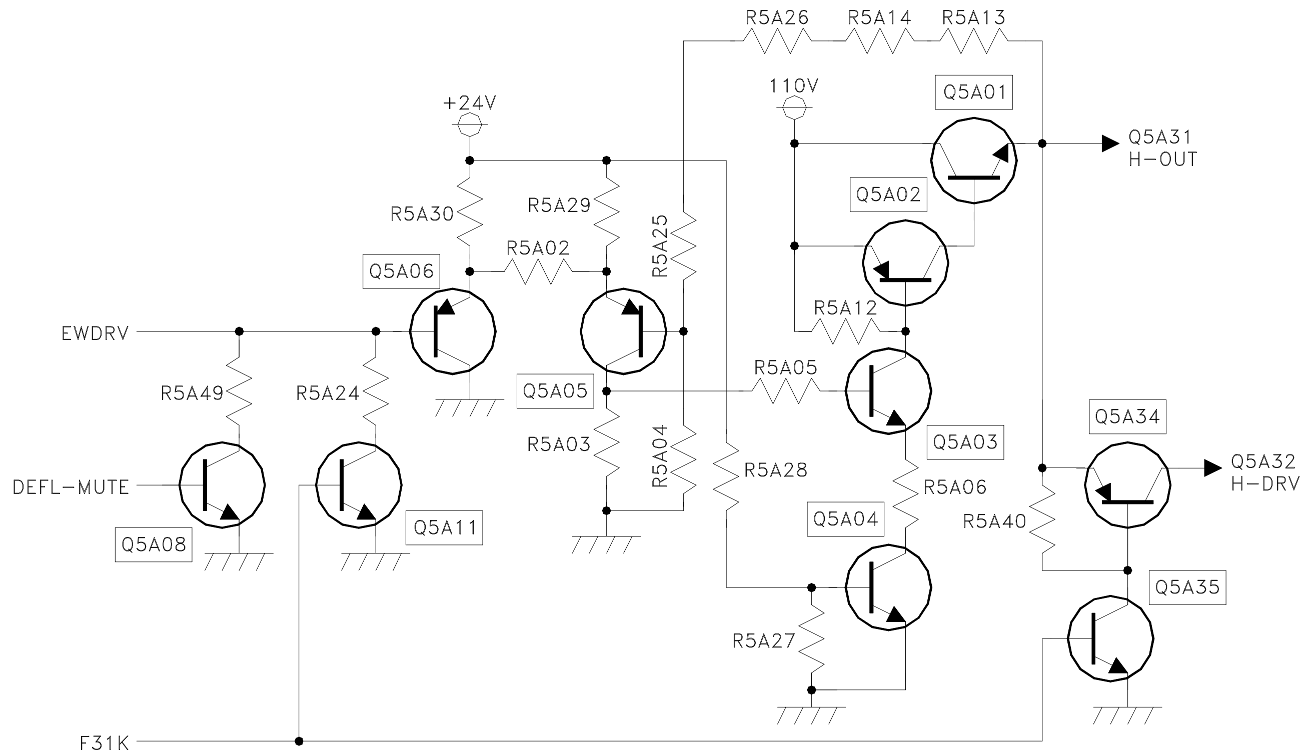


Figure 6-6: Horizontal Deflection DC Supply Circuitry

The DEFL-MUTE line from the µPC and Q5A08 reduce the DC supply during scan frequency change by the same method.

The DC supply for the Horizontal Drive transistor, Q5A32, is derived from the Horizontal Output DC supply through R5A36, R5A37 and Q5A34. In the 31.5 kHz mode, the DC supply for Q5A32 would drop, since the supply for Q5A31 decreases.

To prevent this the 31K control line also connects to the base of Q5A35. When Q5A35 is driven into conduction, the conduction of Q5A34 is increased to maintain the DC supply for Q5A32.

Deflection Loss Detection

To prevent damage to the CRTs, the TV must shut Off if deflection is lost. The Deflection Loss Detection circuit is similar to previous models, as shown in *Figure 6-7*.

Q4B01 monitors vertical deflection, and Q5A38 monitors horizontal deflection. The conduction of both transistors holds their respective collector voltage below the forward bias point of the diode in their collector circuit's (D4B04 or D5A12).

If either Q4B01 or Q5A38 stop conducting, indicating a loss of deflection, the increase in that transistor's collector voltage drives the V-Blank line High. The V-Blank line goes to the CRT Protect circuitry and immediately removing all drive to the CRTs.

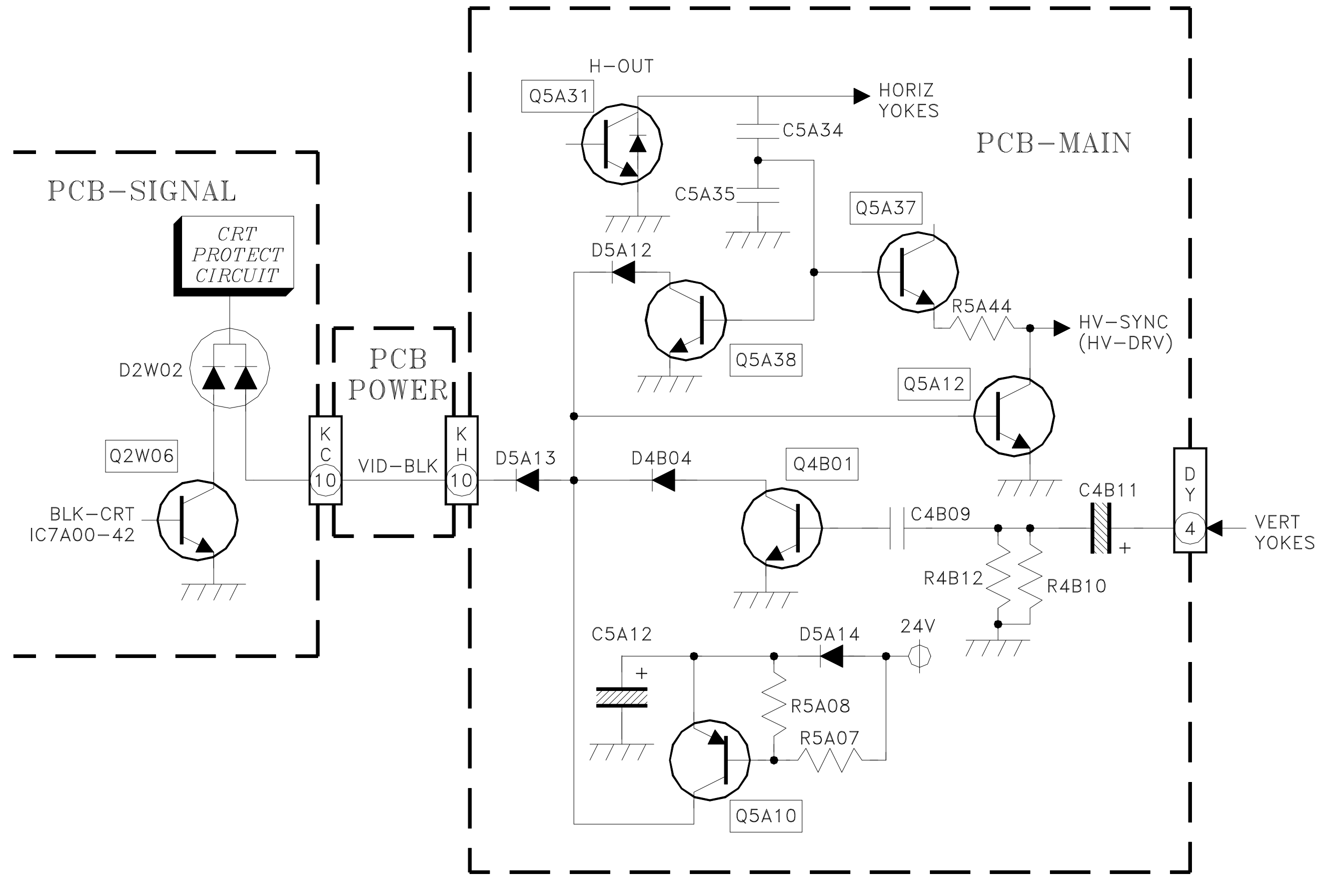


Figure 6-7: Deflection Loss Detection

HV & HV Regulation

Figure 6-8 illustrates the HV and HV Regulation circuitry. Drive from the Horizontal Deflection Output circuitry is applied the HD-IN input of IC5A00. IC5A00 amplifies the signal which is output at pin 1, and through Q5A07 and Q5A09, is applied to the gate of Q5A51.

The output of Q5A51 is the drive signal for the Flyback transformer, T5A51. In the Flyback, the signals are stepped up and rectified to generate the HV and Focus voltages for the three CRTs.

The amount of HV generated depends of the conduction time of Q5A51, the longer the conduction time the more energy supplied to the Flyback, and HV increases. HV is regulated by controlling the duty cycle of the drive signal to Q5A31.

A sample of the HV, HV-DC-FB, is derived from an internal resistive divider in the Flyback and is output at pin 13. The HV sample is applied to the non-inverting input of an OP-Amp in IC5A01. The HV ADJ voltage in applied to the inverting input of a second OP-Amp in IC5A01. The outputs of both OP-Amps are combined and directed to pin 4 of IC5A00.

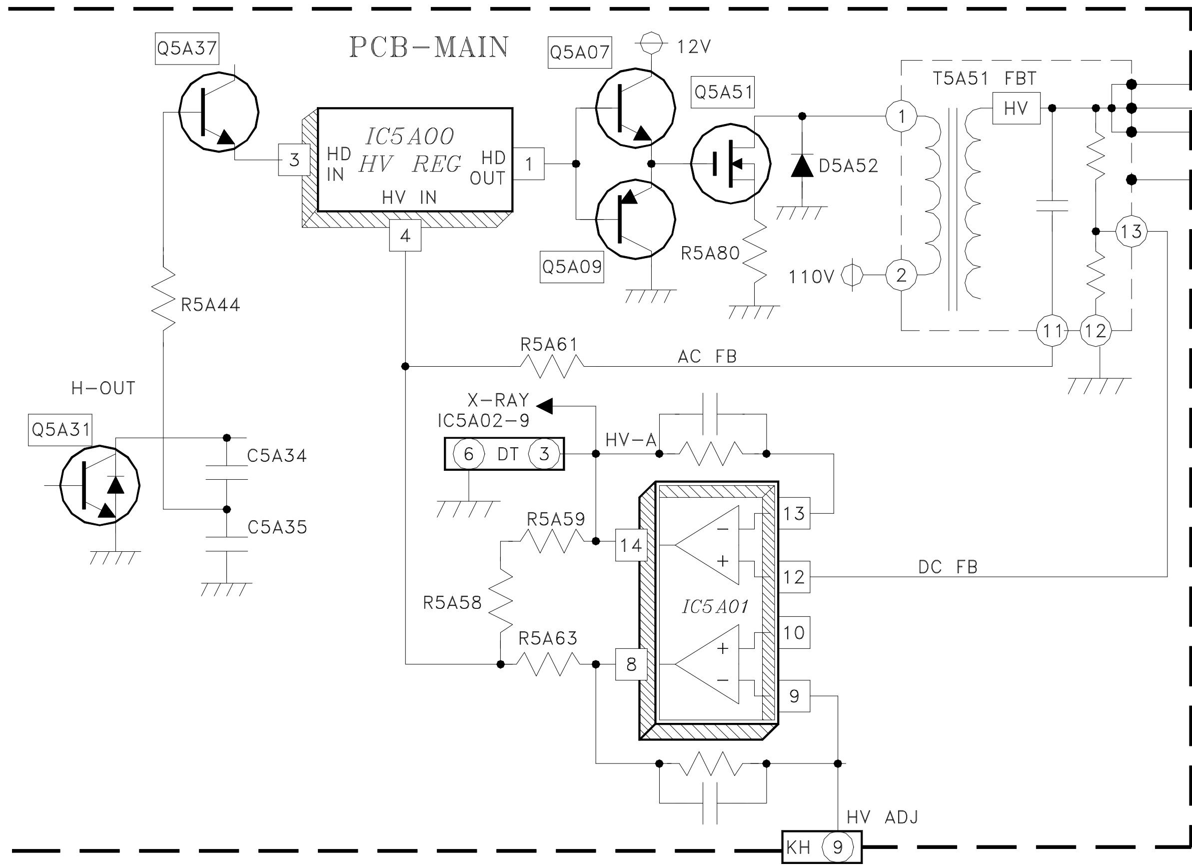


Figure 6-8: HV Circuitry

DO NOT measure the HV-DC-FB voltage at pin 13 of the T5A51. The meter may load down the internal resistive divider, resulting in excessive HV.

X-Ray Protect

X-Ray Protect circuitry is the basically the same as in previous models, as shown in *Figure 5.* The X-Ray Protect circuit in the V20 monitors three items:

1) Q5A51 (HV Output) current, by monitoring Q5A51 source voltage.
2) Excessive HV, by monitoring the rectified voltage from D5A57.
3) Excessive CRT Beam current, by monitoring the voltage at pin 8 for T5A51.

Each of the monitored sources is applied to an input of an OP-Amp in IC5A02. The second input of each OP-Amp is connected to a specific reference. The outputs of all three Op-Amps are tied together at the X-Ray line.

The X-Ray line is normally High. If any of the monitored sources exceeds its' specific reference the X-Ray line is pulled Low, shutting Off the TV.

The connection from the source of Q5A51 to pin 5 of IC5A00 provides further protection. If the source voltage becomes excessive (excess current), IC5A00 immediately removes all drive to Q5A51.

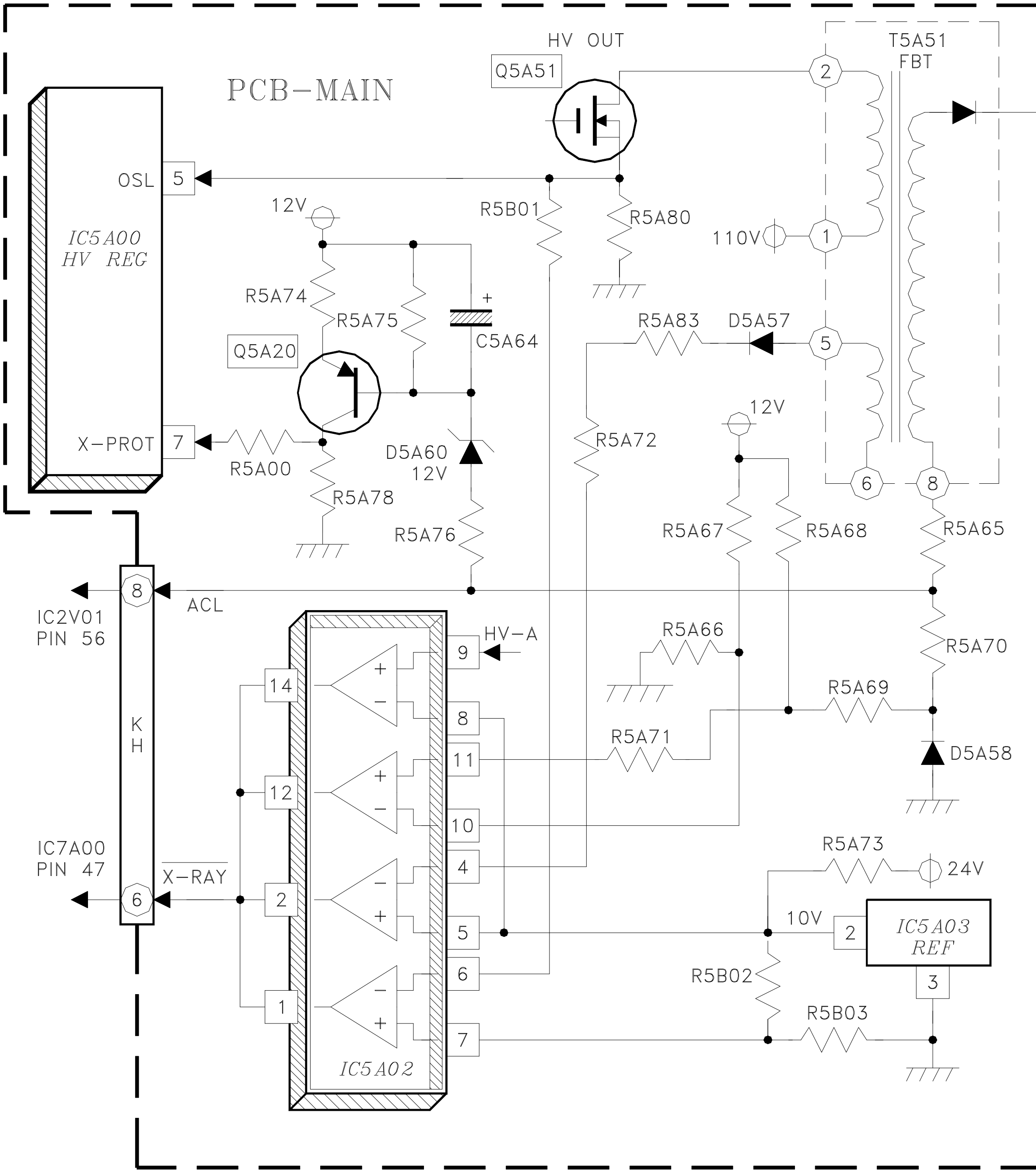


Figure 6-9: X-Ray Protect

Q5A20 and its associated circuitry comprise an Arc Protect circuit. If a CRT Arcs this circuitry immediately removes HV Drive.

If X-Ray Protect shuts the TV Off, pressing the Power button will turn the TV back On (it may shut Off again if the problem still exists). If Arc Protect is activated, the TV must be switched Off before it can be switched back On.

Chapter 7
Convergence Circuitry

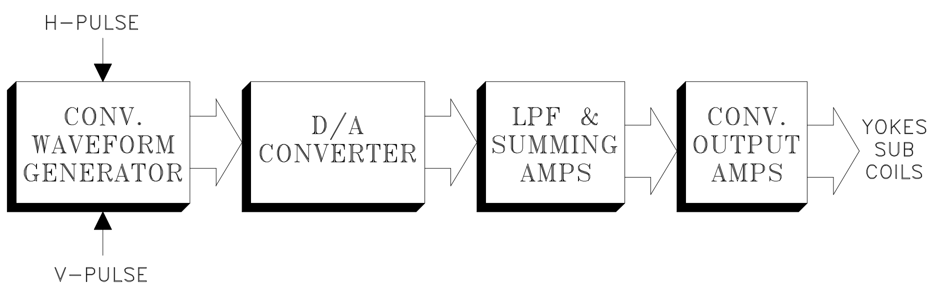


Figure 7-1: Convergence Circuitry - Overall Block Diagram

The Overall Block Diagram in *Figure 7-1* shows the the V23 Convergence Circuitry.. A Waveform Generator generates the convergence correction signals timed from horizontal and vertical sync pulses. The correction signals from the Waveform Generator are in a serial digital format.

The following Digital/Analog Converter changes the digital signals to analog signals. The analog signals from the D/A Converter are directed LPF (Low Pass Filter) and Summing Amplifiers. Any remaining high frequency digital signals are removed and the analog correction signals are amplified. Green correction signals are added to the red and blue signals in the Amplifiers, hence the name Summing Amplifiers.

The correction signals are amplified by Output Amplifiers and are directed to the sub coils in their respective Deflection Yokes.

This is the same basic circuitry used in the last few chassis types. There are only two major differences in V23 Convergence circuitry compared to that in the V21.

1) In the V23, the Waveform Generator is on the PCB-SIGNAL, not on a separate plug-in PCB.
2) Two Convergence Output ICs are used in the V23, only one was used in the V19.

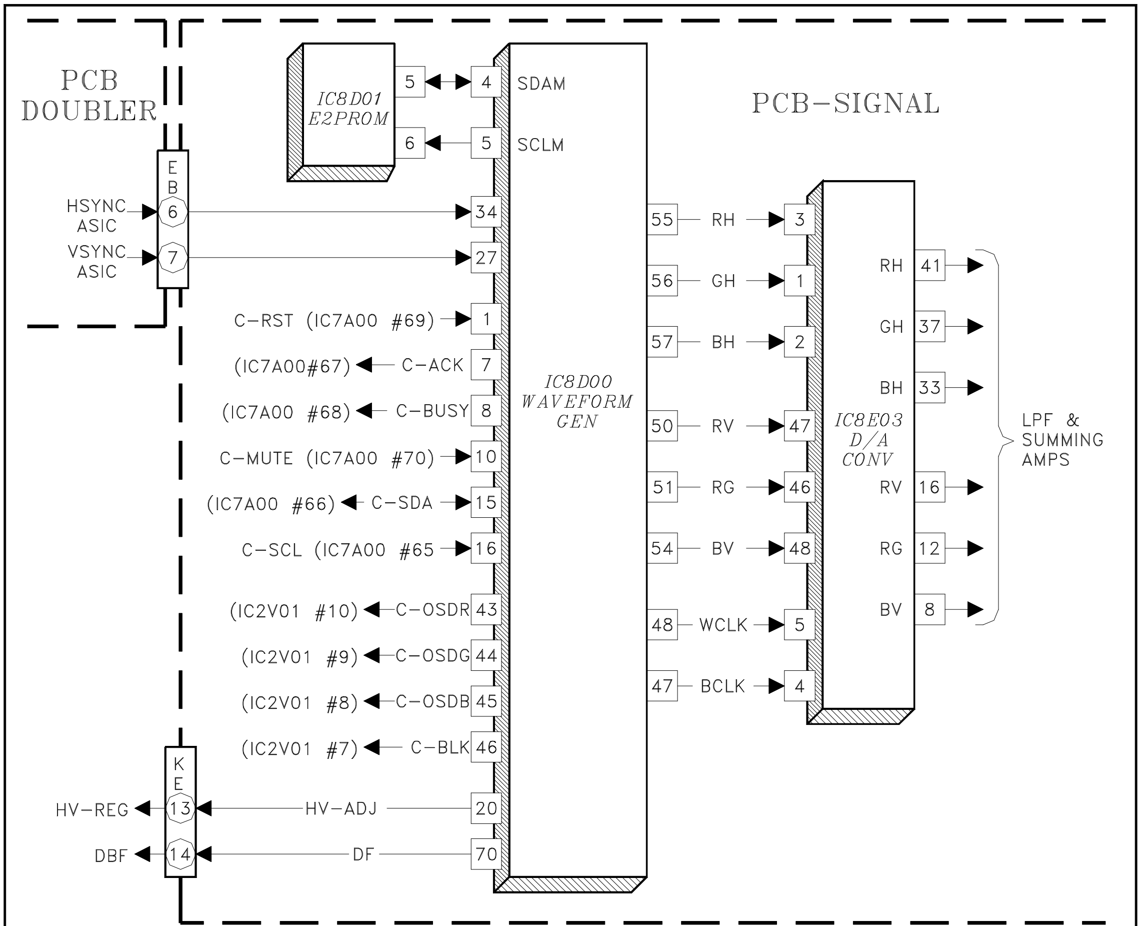


Figure 7-2: Convergence Waveform Generator & D/A Converter

Waveform Generator & D/A Converter

Figure 7-2 illustrates the Convergence Waveform Generator and Digital/Analog Converter circuitry. Horizontal Sync from the doubler circuitry is applied to pin 34 of IC8D00. Vertical Sync is applied to pin 27. From these two signals, IC8D00 generates six Convergence Correction signals, consisting of horizontal and vertical correction signals for each CRT.

Correction signals from IC8D00 are converted to analog signals in IC8E03 and are then directed to LPF and Summing Amplifiers.

Convergence Control signals are also shown in *Figure 7-2*. These include:

- C-SCL … Serial Clock
- C-SDA … I²C Data line
- C-MUTE … disables the Convergence circuitry when the set is first powered on, off, and when exiting the convergence mode (when data is stored in memory).
- C-BUSY … Allows IC8D00 to notify the µPC if it is busy.
- C-ACK … Acknowledgment line, allows notification to the µPC that a command was received.
- C—RST … Convergence Reset

IC8D00 also generates the signals for the internal crosshatch pattern. These are the C-OSDR, C-OSDG and C-OSDB signals that are directed to the VCJ. The C-BLK signal from IC8D00 times the crosshatch pattern insertion in the picture.

Two additional signals from IC8D00 are HV-ADJ and DF. HV-ADJ is set by the service HV adjustment and is directed to the HV Regulation circuitry. DF (Dynamic Focus) is a parabolic signal used by the DBF (Dynamic Beam Focus Circuitry).

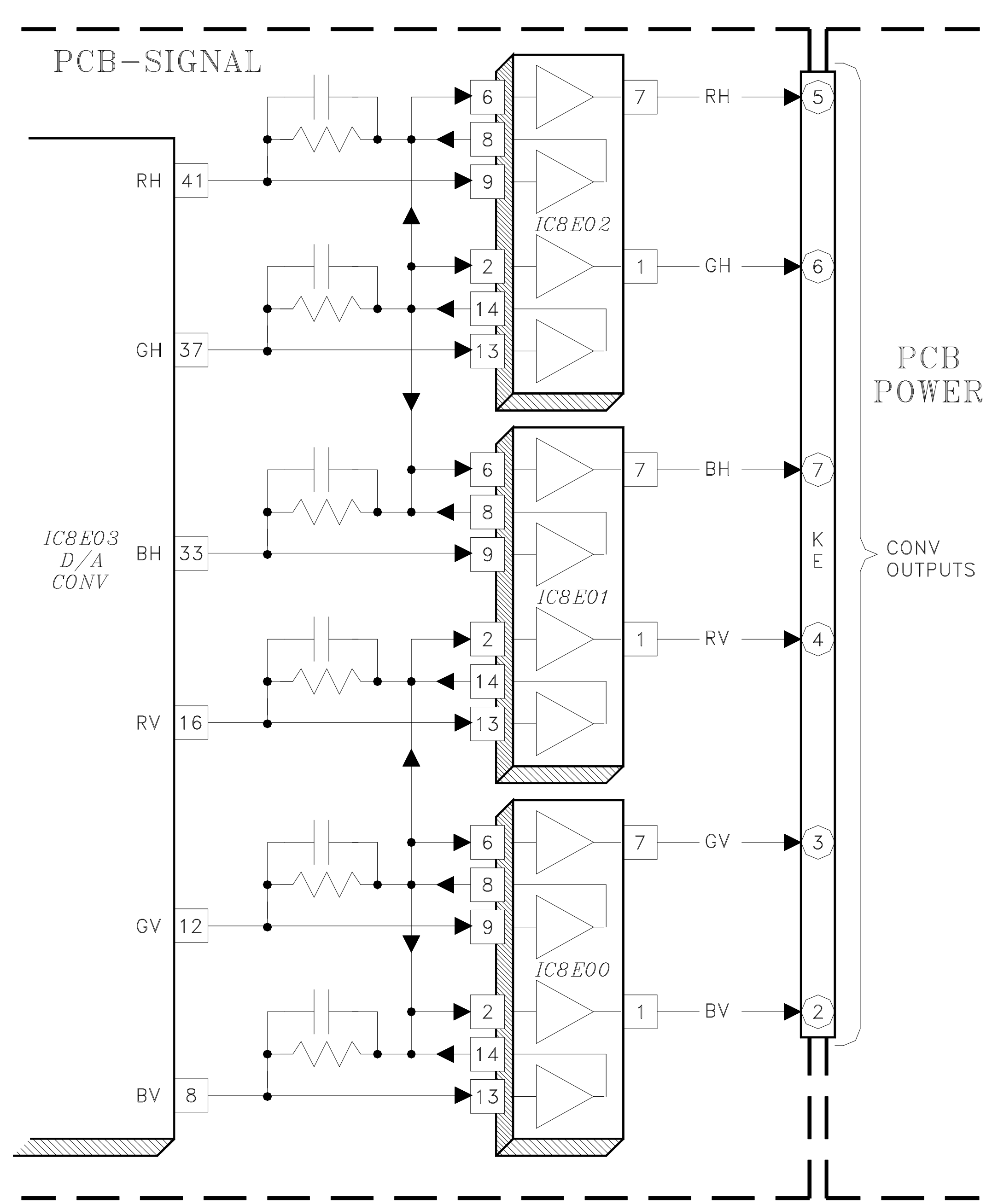


Figure 7-3: Low Pass Filter and Summing Amplifiers

LPF & Summing Amps

Figure 7-3 illustrates the LPF and Summing Amplifiers. The circuitry consists of three ICs, IC8E00, IC8E01 and IC8E02. Each correction signal from IC8D00 goes through two stages of amplification:

1) The first stage is part of the LPF.
2) The second stage is the Summing Amplifier.

Green horizontal and vertical correction signals are added to the Red and Blue Summing Amplifier inputs.

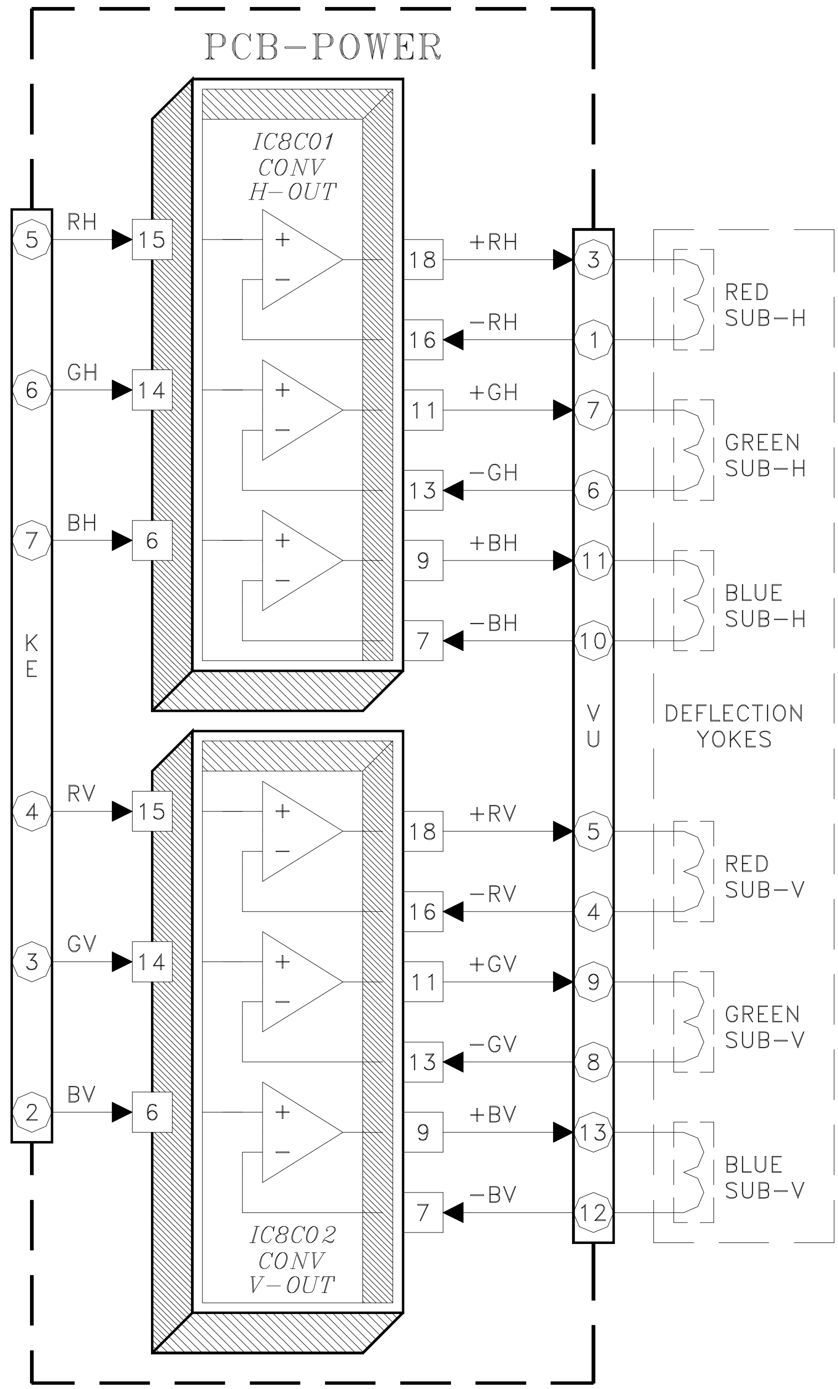


Figure 7-4: Convergence Output Circuitry

Convergence Output Circuitry

Figure 7-4 shows the Convergence Output circuitry located on the PCB-Power. The correction signals are amplified and directed to the Sub Vertical and Sub Horizontal coils located within their respective red, green and blue Deflection Yokes.

Chapter 8
Sound Circuitry

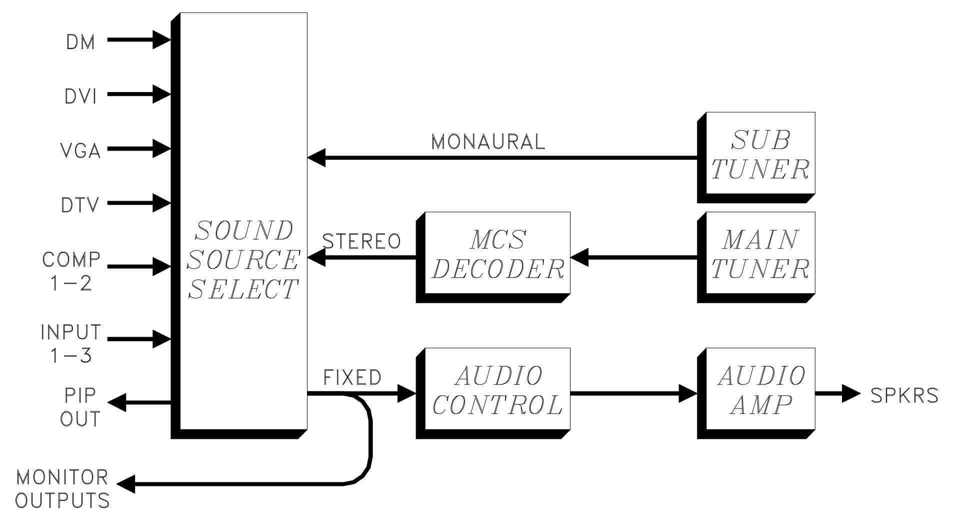


Figure 8-1: Sound Circuitry - Overall Block Diagram

The V23 Sound Circuitry is shown above in the Overall Block Diagram, *Figure 8-1*.

The Sound Source Select circuitry selects the sound source for both the main and sub pictures. The sources correspond to the Video Inputs:

- Main Tuner
- Sub Tuner (monaural only)
- Three External NTSC Inputs
- Two Component Inputs (DVD)
- DTV
- DVI
- VGA
- DM (Analog Audio from a digital source)

The sound signal from the DM Module is initially received in a digital format, from the ATSC/QAM Tuner or the IEEE 1394 inputs.

The remainder of the circuitry is conventional:

- MCS Decoder circuitry decodes the Main Tuner sound signal, generating mono, stereo, or SAP signals when broadcast.
- Main picture sound from the Select circuitry takes two paths:
  1) To Audio Control circuitry
  2) To the Monitor Outputs
- The Audio Control circuitry performs adjustments to the Volume, Treble, Bass, etc. The outputs from Audio Control circuit are directed to the Audio Amplifier, and then to the set's speakers.
- Sub picture (PIP) sound, from the Source Select circuit is directed to the PIP Sound Output Jacks.

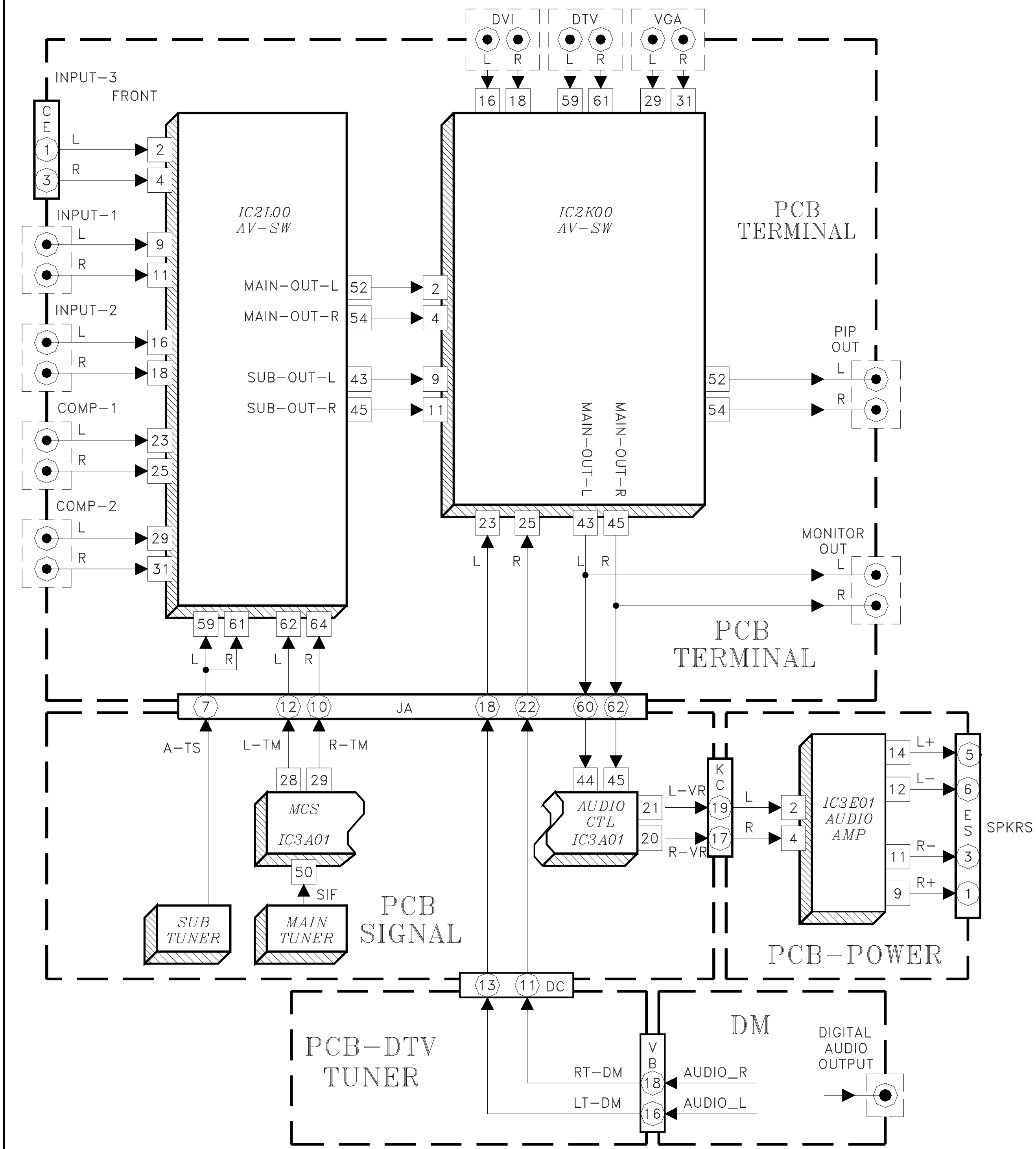


Figure 8-2: Overall Sound Circuitry Block Diagram

Overall Sound Signal Path

Figure 8-2 illustrates the Overall Sound Circuitry Block Diagram. The AV/SW ICs, IC2L00 and IC2K00, used to select Main and Sub Picture Video/ Color are also used to the select the Sound sources.

IC2L00 selects Main and Sub sound sources from the Main Tuner (decoded by MCS circuitry in IC3A01), Sub Tuner, External NTSC Inputs 1-3 and from Component Inputs 1 and 2. The selected signals are directed to IC2K00.

IC2K00 selects the signals from either IC2L00, DVI, DTV, VGA Inputs or the DM Module.

The Sub (PIP) sound signal is routed from IC2K00 to the PIP Sound Output Jacks. The selected main Sound signal is directed to Audio Control circuitry, also in IC3A01. The sound signal from IC3A01 is amplified in IC3E01 and directed to the speakers.

The input signals to IC3A01 are also directed to the Monitor Output Jacks. Only fixed level sound is available at the Monitor Output Jacks.

Digital Audio Output

There is one additional audio output signal in the V23 chassis, External Digital Audio Output on the rear of the DM. This is an AC-3 digital data stream (when available from a digital source). It allows connection to an external A/V Receiver with an AC-3 Decoder. If the signal has been fully encoded, the AC-3 Decoder is capable of producing 5.1 surround sound, 5 full audio channels (20 kHz) and one low frequency enhancement channel (120 Hz).

Chapter 9
Troubleshooting Tips

LED Indications	Conditions	Probable Cause
Off	After AC is applied	No Standby Power or TV µPC not running
Fast Blink for 70 sec.	After AC is applied	Normal - DM µPC is booting up.
Fast Blink for 70 sec.	Each time TV is switched On	Power Save Mode is activated
Fast Blink (Doesn't stop)	After AC is applied	TV µPC is running, but DM failed to boot up
Slow Blink	Set is Off	Normal - Timer is set for Auto Turn On

Table 9-1: Power LED Indications

Use the following tips when troubleshooting the source of a problem in the V23 chassis.

Using The Front Panel LED

The Front Panel LED helps isolate the cause of the following problems.

- The TV will not turn On.
- The TV turns On, and then Shuts Off.

If the TV will not turn On, the LED response indicates the possible cause of the problem. *Table 9-1* lists the possible LED response when this problem occurs.

When the TV turns On and then shuts Off, the LED Diagnostic Error codes help isolate the problem. This is the same LED Diagnostic featured on some previous model TVs.

Figure 9-1 shows the LED Error Code Activation Procedure, an is describe in the following:

1) With the TV Off
2) Press and hold the front panel "MENU" and "DEVICE" buttons for 5 seconds.
3) The LED will flash the Error Code indicating what caused the TV to shut Off.
4) The Error Code will be repeated 5 times.
5) When the LED stops flashing the mode is automatically terminated.

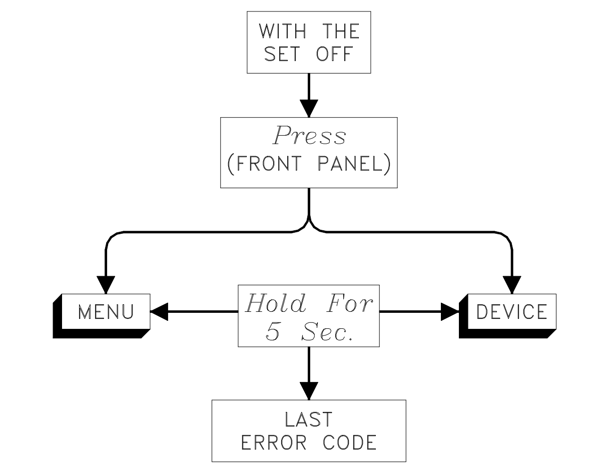


Figure 9–1: LED Error Code Activation

Reading the Error Codes

The Error Codes are two digit numbers. The LED:

- Flashes the value of the most significant digit (MSD).
- Then there is a pause.
- Flashes the value of the least significant digit (LSD).
- The Error Code is repeated 5 times.

As an example, *Figure 9-2* illustrates the LED drive for Error Code "23". *Table 9-2* lists the Error Codes and their possible cause.

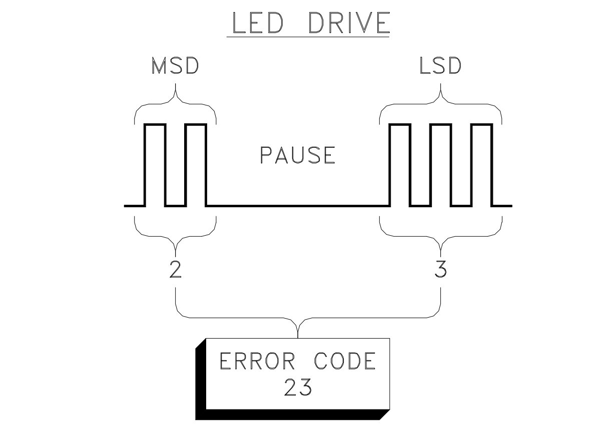


Figure 9-2: Reading Error Codes

DM Module Check

When the TV turns On, but a problem exists that may be caused by the DM Module, perform the following two checks:

1) Select the DTV Antenna as the source an select and HD Channel.
2) Select an analog 480i signal as the source and note if an On Screen Display (OSD) is present.

The ability to display Menus and receive an HD channel indicates the DM Assembly is functioning properly.

Except for the convergence crosshatch, all OSD signals are generated in the DM Module. When there is no OSD using a 480i source, the DM assembly may be the cause of the problem. However, before condemning the DM, make certain it is properly seated onto the PCB-DTV TUNER and that all connections between the PCB-DTV TUNER and PCB-SIGNAL are secure.

NetCommand™ Control Problems

If devices in a Home Theater System cannot be controlled properly with NetCommand, the Remote Control may not be in the NetCommand Operational Mode. To put the Remote in the NetCommand Mode:

1) Set the Remote to the TV Layer.
2) Point the Remote away from the TV.
3) Press and Hold the "POWER" button and enter "9-3-5" in sequence.

Error Code	Probable Cause
12	No error detected
21	X-Ray Protect
22	Short Protect
23	Loss of Deflection

Table 9-2: Error Codes

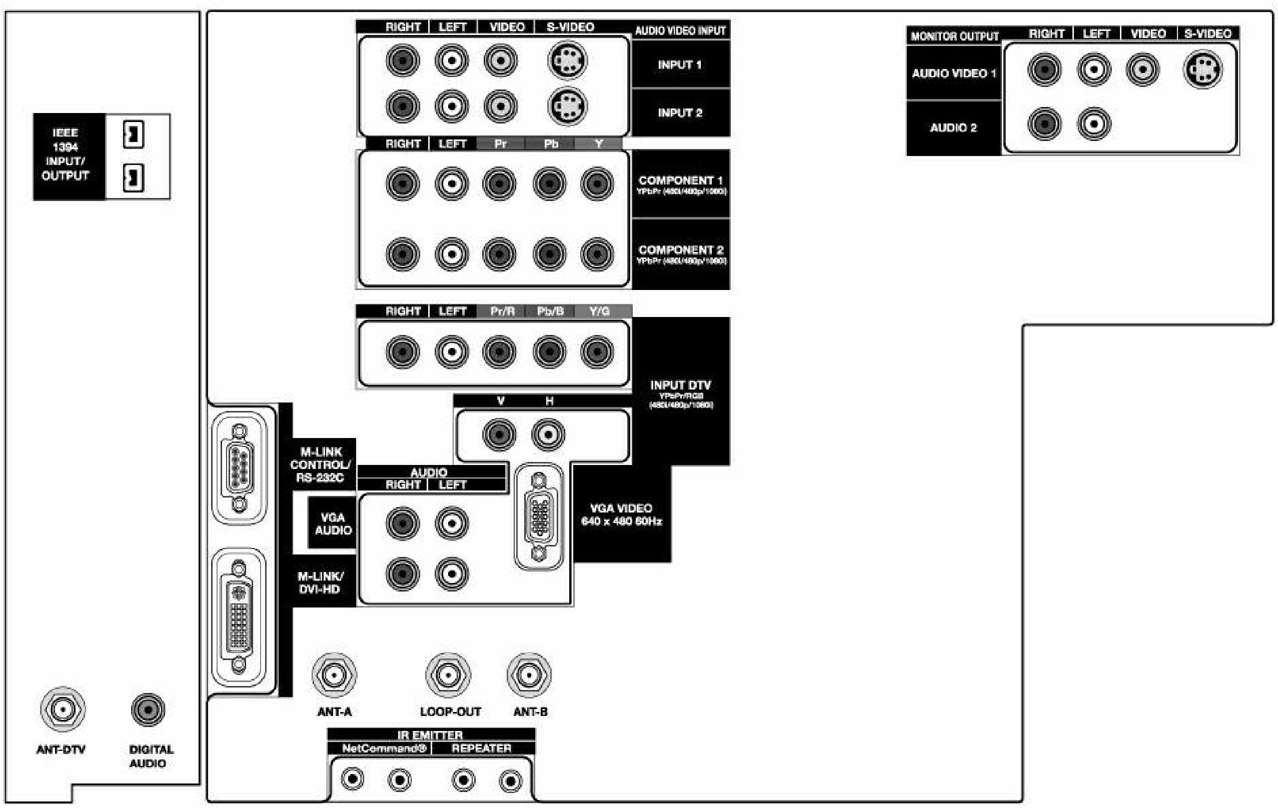
CRT Phosphor Protection

Troubleshooting problems in the CRT Protect, Deflection Loss Detection and the Deflection circuits, sometimes involves disabling the CRT Protect circuitry and then Powering up the TV.

However, first disable the CRTs to prevent any possible phosphor damage.

1) Unplug the SP connector at the PCB-CRT(R). This removes the filament voltage to all three CRTs.
2) Remove zener diode D5A13 on PCB-MAIN. This disables the CRT Protect circuit.

The set then can be switched on for troubleshooting without damaging CRT phosphors.


IEEE
1394
INPUT/
OUTPUT
ANT-DTV
DIGITAL
AUDIO
RIGHT
LEFT
VIDEO
S-VIDEO
AUDIO VIDEO INPUT
INPUT 1
INPUT 2
RIGHT
LEFT
Pr
Pb
Y
COMPONENT 1
COMPONENT 2
RIGHT
LEFT
Pr/R
Pb/B
Y/G
INPUT DTV
V
H
M-LINK
CONTROL/
RS-232C
AUDIO
RIGHT
LEFT
VGA
AUDIO
VGA VIDEO
640 x 480 60Hz
M-LINK/
DVI-HD
ANT-A
LOOP-OUT
ANT-B
IR EMITTER
NetCommand®
REPEATER
MONITOR OUTPUT
RIGHT
LEFT
VIDEO
S-VIDEO
AUDIO VIDEO 1
AUDIO 2

T/M V23